PHYSICS ABSTRACTS

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of

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NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers. (An abridged version of the U.D.C. accompanies the Annual Index.) An abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

Abstracts signed with the following initials have been supplied by the courtesy of the organizations named: "B.A." = British Abstracts. "E.R.A." = British Electrical and Allied Industries Research Association. "M.A." = Metallurgical Abstracts. "M.R." = Mathematical Reviews. "M.-V." = Metropolitan-Vickers Electrical Co., Ltd. "P.O." = Post Office Engineering Department.

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MATHEMATICS 51

512.83 : 531.391.1 2007

Factorization of a class of determinants and applications to dynamical chains. DUNCAN, W. J. *Phil. Mag.*, **36**, 615–22 (*Sept.*, 1945).—Let $U = (u_{ij})$ be a numerical square matrix, of order n, whose latent roots are all distinct and let P and C be square numerical or λ-matrices of order m. The square matrix considered is

$$F = \begin{pmatrix} P + u_{11}C, & u_{12}C, \ldots \\ u_{21}C, & P + u_{22}C, \ldots \\ \cdot & \cdot \\ \cdot & \cdot \end{pmatrix}$$

The determinant of F, of order mn, may be factorized into the product of n determinants of order m, thus

$$|F| = \prod_{s=1}^{n} |P + \rho_s C|$$

where $\rho_1, \ldots, \rho_n$ are the roots of U. Applications to a dynamical chain consisting of physical elements or links arranged linearly so that each link is coupled only to one or two of its nearest neighbours are considered. An example considered in detail is that of a segmented wing. L. S. G.

517.512 2008

Contributions to the problem of approximation of equidistant data by analytic functions. A. On the problem of smoothing or graduation. A first class of analytic approximation formulae. SCHOENBERG, I. J. *Quart. Appl. Math.*, **4**, 45–99 (*April*, 1946).—The very smooth approximations developed in the present paper find particular application in ballistics and actuarial mathematics. A study is made of the Lagrange type of formula which combines the operation of smoothing of data and the operation of interpolation in one formula. This formula is of the form

$$F(x) = \sum_{n=-\infty}^{\infty} y_n L(x - n) \qquad (1)$$

where $y_n (n = 0, \pm 1, \pm 2, \ldots)$ are the given data and $L(x)$ is an even function. After a discussion of smoothing and smoothing formulae the interpolatory properties of formula (1) are described in terms of the properties of the Fourier transform,

$$g(u) = \int_{-\infty}^{\infty} L(x) \cos ux dx$$

Polygonal lines, the individual areas of which are polynomials of degree $k - 1$, joined together with $k - 2$ continuous derivatives are next discussed. These curves may be smoothed out into what are called analytic spline curves of order k and these may be used to approximate given data. The methods for accurately computing the functions and constants involved are stated and necessary tables for applying the results are given. L. S. G.

517.516 : 621.396.677 2009

Laguerre functions in the mathematical foundations of the electromagnetic theory of the paraboloidal reflector. PINNEY, E. *J. Math. Phys.*, **25**, 49–79 (*Feb.*, 1946).—The scalar wave equation in paraboloidal co-ordinates is separable and the solution of the separated equation is expressible in terms of the two solutions, $L_\nu^\mu(z)$ and $U_\nu^\mu(z)$, of Laguerre's equation. The properties of these two functions are developed in great detail. A number of analytical expressions for them are given and various integrals involving the functions are evaluated. The solution to the wave equation is expressible directly in terms of

$$S_\nu^\mu(z) = Z^{\frac{1}{2}\mu} e^{-\frac{1}{2}z} L_\nu^\mu(z), \; V_\nu^\mu(z) = Z^{\frac{1}{2}\mu} e^{-\frac{1}{2}z} U_\nu^\mu(z)$$

and various properties of these two functions are deduced. The mathematics presented in this paper provides a basis for the rigorous theory of the paraboloidal reflector. L. S. G.

517.564 2010

A note on Bessel functions of purely imaginary argument. MONTROLL, E. W. *J. Math. Phys.*, **25**, 37–48 (*Feb.*, 1946).—A difference-differential equation which occurs frequently in physical problems is

$$ay_{n+1} - (a + b + d/dt)y_n + by_{n-1} = 0 \qquad (1)$$

where $y_n = y_n(t)$ and $n = 1, 2, \ldots, N$. The solution of this equation may be written as an infinite series of functions $I_n(x)$. The value of x is found which maximizes $e^{-\alpha x} I_n(x)$ and asymptotic formulae are found for $I_{n-1}(\beta n)/I_n(\beta n)$, $I_{n+1}(\beta n)/I_n(\beta n)$ and $I_n(\beta n)$ when n is large and $\beta > 0$. These results are used to discuss the solution of (1). An appendix gives an asymptotic formula for

$$\int_a^b \exp\{nf(x)\}dx$$

where $f(x)$ is a continuous function with a single maximum in the interval (a, b). L. S. G.

517.566 2011

On the computations of Mathieu functions. BLANCH, G. *J. Math. Phys.*, **25**, 1–20 (*Feb.*, 1946).—A method is given for correcting the characteristic values of Mathieu's differential equation and the corresponding Fourier coefficients for the periodic solutions, both of which may be obtained by known methods. An expression for the error in the ratio of two successive coefficients, in terms of the error in the characteristic value, is also given. Two examples are studied. L. S. G.

517.6 : 536.21 2012

Some applications of the repeated integrals of the error function. JAEGER, J. C. *Quart. Appl. Math.*, **4**, 100–3 (*April*, 1946).—The integrals are $I_n(n = 0, 1, 2, \ldots)$ where

$$I_n E(x) = \int_x^\infty I_{n-1} E(\xi) d\xi \qquad (n = 1, 2, \ldots)$$

and they arise in problems on the conduction of heat in solids. A relation concerning the Laplace transform of a function involving I_n is proved and used in deducing the solutions of a number of problems of practical interest which involve heat generation in the solid (e.g. the hydrating of cement). L. S. G.

517.7 : 518.2 2013

Auxiliary table of complete elliptic integrals. KAPLAN, E. L. *J. Math. Phys.*, **25**, 26–36 (*Feb.*, 1946).—Tables, correct to 10 decimal places, are given of the values of the integrals

$$K = \int_0^{\frac{1}{2}\pi} (1 - k^2 \sin^2\theta)^{-\frac{1}{2}} d\theta \qquad E = \int_0^{\frac{1}{2}\pi} (1 - k^2 \sin^2\theta)^{\frac{1}{2}} d\theta$$

as functions of $\lambda = -\log_{10}(1 - k^2)$ for $\lambda = 1(\cdot 005)2(\cdot 01)6$. L. S. G

518.2 : 517.7 *see Abstr.* 2013

519.283 : 620.113 201

Statistical methods in quality control. X. Classification of defects and quality rating. *Elect. Engng, N.Y.* **65**, 117–19 (*March*, 1946).

ASTRONOMY . GEODESY 52

521.03 : 621.396.9 2015

Project Diana. Army radar contacts the moon. WEBB, H. D. *Sky and Telescope*, **5**, 3–6 (*April*, 1946).—[Abstr. 1938 B (1946)].

523.11 : 531.51 : 530.12 = 3 2016

The one-body problem in the Einstein–de Sitter expanding universe. JARNEFELT, G. *Ann. Acad. Sci. Fenn. A* (*No.* 12) 38 *pp.* (1942) *In German.*—The first part of the paper deals with the reduction of certain differential forms:

$$ds^2 = e^{\nu(r,t)}dt^2 - e^{\lambda(r,t)}(dr^2 + r^2d\theta^2 + r^2\sin^2\theta d\phi^2)$$

to the standard co-ordinates, ρ, τ in which

$$ds^2 = H(\rho,\tau)d\tau^2 - G(\rho,\tau)d\rho^2 - \rho^2d\theta^2 - \rho^2\sin^2\theta d\phi^2$$

The two cases considered are (1) the Einstein–de Sitter universe in which $\nu = 0$, $\lambda = g = \frac{4}{3}\log(1 + \frac{3}{2}k_0t)$ (k_0 = constant) and (2) McVittie's form for a particle of mass m at the origin of co-ordinates in this universe for which

$$\nu = 2\log\left(\frac{1-m/2re^{\frac{1}{2}g}}{1+m/2re^{\frac{1}{2}g}}\right), \quad \lambda = 4\log(1+m/2re^{\frac{1}{2}g}) + g$$

The functions H and G are found in McVittie's case as power-series in the two variables $x = \rho^{-1}$, $y = k_0^2\rho^2/(1 + \frac{3}{2}k_0\tau)^2$. These series are then generalized and a more general field than McVittie's is obtained, still with a particle of mass m at the origin. In this more general field, the orbits of planets traced out round the particle are shown to be unaffected by the expansion of the universe as a whole. G. C. McV.

523.165 : 621.396.821 2017

Interstellar origin of cosmic radiation at radio-frequencies. GREENSTEIN, J. L., HENYEY, L. G., AND KEENAN, P. C. *Nature, Lond.*, **157**, 805–6 (*June* 15, 1946).—The measured radiation from interstellar space [Abstr. 1205 (1946), 2112 (1945)] agrees closely with the value calculated for free-free transitions by electrons in the field of protons in interstellar space [*Astrophys. J.*, **91**, 625 (1940)]. The suggestion [Abstr. 897 B (1946)] that the origin of this radiation is to be found in "bursts" from stars is shown to be untenable.

523.823 : 523.851.1 = 4 2018

The masses of a non-resolvable system of stars. DURAND, G. *C.R. Acad. Sci., Paris*, **222**, 275–7 (*Jan.* 28, 1946) *In French.*—The application of the mass-luminosity law to a system of stars which are so close together that they cannot be observed individually is considered. The mass-luminosity law is a linear, or an approximately linear, relation between the logarithm of the mass of a star and its absolute bolometric magnitude. The principal result of the investigation is the value of the relative error in the mass of the system which results by applying the mass-luminosity law to the system as a whole instead of to each individual star. G. C. McV

523.83 2019

The space motions of the cluster variables. MCLEOD N. W. *Astrophys. J.*, **103**, 134–8 (*March*, 1946).—The available radial velocities (67 stars) for stars of this type gave a solar motion of 157 km/sec towards the apex $\alpha = 20^h50^m$, $\delta = +59°$, whilst the available tangential motions (58 stars) gave 142 km/sec towards $\alpha = 21^h24^m$, $\delta = +38°$. Four different solutions were completed of the velocity ellipsoid but these were in disagreement. The velocity dispersion along the axis in the direction of the galactic centre was 170 km/sec whilst it was 50 km/sec in that of the galactic poles. SW Bootis, RZ Cephei and U Comae are possibly in retrograde motion about the galactic centre. G. C. McV

523.841.1 2020

The relation between light curves and luminosities of novae. MCLAUGHLIN, D. B. *Publ. Astr. Soc. Pacif.*, **57**, 69–80 (*April*, 1945).—Nova luminosities are determined from expansions of nebular shells, interstellar line intensities, galactic rotation and occurrence in the Andromeda nebula, greater Magellanic cloud and Sagittarius cloud. The rate of decline (defined as the time taken to fall 3 magnitudes from maximum) shows strong correlation with luminosity, the slower novae being fainter. The relation holds between the limits $M = -9$ to $-3\cdot6$; some supernovae, "permanent" and "dwarf" novae do not fit the relation. D. L. E.

523.841.372.4.035.92 2021

Six-colour photometry of stars. IV. Variation of α Ursae Minoris at different wavelengths. STEBBINS, J. *Astrophys. J.*, **103**, 108–12 (*March*, 1946).—Gives the amplitude of the light variation of Polaris [see Abstr. 2708 (1945)]. The variation measured is $\frac{1}{9}$ of the corresponding variation for δ Cephei. The period of the variation has increased over that predicted by any of the old formulae. E. G. M.

523.841.9 2022

Orbital elements of the Algol variable SS Bootis. SANFORD, R. F. *Astrophys. J.*, **103**, 114–16 (*March*, 1946).

523.841.9 : 523.877 *see Abstr.* 2028

523.851.1 : 523.823 = 4 *see Abstr.* 2018

523.87 2023

Spectra of BD stars within five degrees of the North Pole. NASSAU, J. J., AND SEYFERT, C. K. *Astrophys. J.*, **103**, 117–32 (*March*, 1946).—A table of about

1 150 stars is given, showing spectral types estimated from objective prism spectra, with luminosity groups (giant or dwarf) for all those of type G2 or later. The percentages of dwarfs are in agreement with those found by other workers, and show a striking decrease from types G2 to G8—indicating the necessity for accurate classification. The selective absorption in this region is found to increase linearly to 0·30 m at 450 parsecs, and to remain constant thereafter. D. L. E.

523.87 2024

The spectrum of Procyon: a typical star of class F. SWENSSON, J. W. *Astrophys. J.*, **103**, 207–48 (*March*, 1946).—An extensive table (about 3 600 lines) is given of wavelengths, estimated intensities and identifications of absorption lines between 3 800 and 6 768 Å from high dispersion spectra. About 8% of the lines are unidentified, most of them being also found in the sun and some late type stars. Many metals show strong lines from both neutral and singly ionized atoms, and most of the rare earths are present. Bands of CN and CH molecules are also faintly recognizable. D. L. E.

523.872 : 535.343 2025

On the continuous absorption coefficient of the negative hydrogen ion. CHANDRASEKHAR, S. *Astrophys. J.*, **102**, 223–31 (*Sept.*, 1945).—Difficulties arising from the fact [Abstr. 825 (1945)] that the absorption coefficient of H^- depends on the wave function of the ground state in regions far from the hydrogenic core are avoided by deriving the absorption cross-section from the matrix element of the momentum operator. The new absorption curve so determined gives a max. at 8 500 Å, where the absorption coefficient is $4{\cdot}37\times10^{-17}$ cm². A. HU.

523.877 2026

On the radiative equilibrium of a stellar atmosphere. VI. CESCO, C. U., CHANDRASEKHAR, S., AND SAHADE, J. *Astrophys. J.*, **101**, 320–7 (*May*); *Erratum*, **102**, 137 (*July*, 1945).—Third-approximation solutions to the problem of line formation in a stellar atmosphere are tabulated [see Abstr. 2137 (1945)], and numerical forms of the solution for the radiative equilibrium of a planetary nebula are obtained. A. HU.

523.877 2027

On the radiative equilibrium of a stellar atmosphere. VII. CHANDRASEKHAR, S. *Astrophys. J.*, **101**, 328–47 (*May*, 1945).—The solution to the equation of radiative transfer when the continuous absorption coefficient varies with wavelength is considered beyond the first approximation provided by the grey-body assumption. The correction to be made to the temperature distribution to allow for material which departs from greyness are evaluated to a second approximation in which the mean absorption coefficient is not Rosseland's mean but is a straight average of values weighted according to the net monochromatic flux in a grey atmosphere at the wavelength concerned. The monochromatic fluxes and their derivatives are evaluated for a range of optical depths. A. HU.

523.877 : 523.841.9 2028

On the radiative equilibrium of a stellar atmosphere. VIII. CHANDRASEKHAR, S. *Astrophys. J.*, **101**, 348–55 (*May*, 1945).—Methods previously developed [see Abstr. 829 (1945)] are applied to the problem of the reflection effect in eclipsing binaries. General solutions are found for the equation of transfer representing the radiative equilibrium of an atmosphere exposed to an oblique beam of parallel radiation. A relation is developed between the angular distribution of the reflected radiation and the law of darkening in an atmosphere characterized by a constant net flux and with no incident radiation. A. HU.

523.877 : 537.562 : 533.75 *see Abstr.* 2062

PHYSICS 53

53.081.3 = 3 2029

Quantity of matter as a fundamental quantity. POHL, R. W., AND STOCKMANN, F. *Z. Phys.*, **122**, 534–8 (1944) *In German.*—Instead of writing "mol. vol. = 22·4 l" it is suggested that the correct expression is "mol. vol. = 22·4 l per MOL" (where MOL is the quantity of matter in 1 gm molecule). This quantity of matter is to be regarded as a fundamental unit, together with the usual units of length, time, mass, temp. and charge. B. A.

53.081.5 : 621.3.011 = 4 2030

Simplification of electric and magnetic dimensions. TARBOURIECH, M. *Rev. Gén. Élect.*, **55**, 151–5 (*April*, 1946) *In French.*—Referring to Brylinski's proposal [see Abstr. 1791 (1946)], tri-basic systems in current, length, time; and current, velocity, time are considered as alternatives; each shows some saving in total number of symbols, but electrostatic and electromagnetic systems still differ. By the adoption of a quadri-basic system this difference may be made to vanish; permeability associated with either *L*, *M*, *T* (classical) or *Q*, *L*, *T* (Brylinski) exemplify this. Alternatives are *L*, *I*, *T* associated with either permeability or voltage, each showing a saving in symbols, but the preferred suggestion is a system based on *R*, *I*, *T* and *L* (ohm, ampere, second and metre), which requires only ¾ of the letters and exponents necessary for the classical *L*, *M*, *T*, permeability system. The abbreviation "O.A.S.M." is suggested to denote this new system. G. F. F.

FUNDAMENTALS 530.1

530.12 : 531.18 *see Abstr.* 2039–2041

530.12 : 531.51 : 523.11 = 3 *see Abstr.* 2016

530.145 2031

Elimination of divergencies in quantum electrodynamics and in meson theory. GUSTAFSON, T. *Nature, Lond.*, **157**, 734 (*June* 1, 1946).

530.145 = 3 2032

Observations on the energy-impulse tensor of the field theories of matter. ISKRAUT, R. *Z. Phys.*, **119** (*Nos.* 11–12) 659–76 (1942) *In German.*—Belinfante's

method [Abstr. 4465 (1939)] of determining the symmetrical energy-impulse tensor is discussed and simplified. The angular momentum and its resolution into orbital angular momentum and spin angular momentum are dealt with in conjunction with the localization of the energy and impulse. A summary of important magnitudes of the scalar, Maxwell, Yukawa and Dirac theories is included for comparison. H. G. S.

530.145 : 535.14 = 4 2033

On the theory of the photon in a Riemannian space. TONNELAT, M. A. *Ann. Phys., Paris*, **15**, 144–224 (*Jan.–March*, 1941) *In French.*—The theory is introduced by a presentation of the equations of the photon in a Euclidean space. The formalism of Dirac's equation and the wave functions with 4 and with 16 components are discussed and these lead to the Maxwellian and non-Maxwellian equations in the theory of the photon. Then the photon equations in a non-Euclidean space are formulated. The space is, in general, supposed to have both curvature and torsion, and the photon equations involve two operators intimately related to the geometry of the space. The compatibility of the equations is discussed. The electromagnetic equations in the photon theory are studied and the second order equations of propagation are given. The final discussion compares the wave and corpuscular theories of light on the basis of the results obtained in the paper. L. S. G.

530.145.1 2034

Quantum equations and nuclear field theories. FLINT, H. T. *Phil. Mag.*, **36**, 635–43 (*Sept.*, 1945).—Dirac's equation for a charged particle in a gravitational and electromagnetic field is modified to include the influence of a nuclear field. The form of the equation is given explicitly in 4 cases. In these the field is characterized respectively by (1) a vector (V_μ), (2) antisymmetric tensors of the second rank, ($V_{\mu\nu}$) and ($T_{\mu\nu}$), (3) tensors of the third rank, ($V_{\lambda\mu\nu}$) and ($T_{\lambda\mu\nu}$) antisymmetric in (λ, μ) and (μ, ν) and (4) tensors ($V_{\lambda\mu\nu\rho}$) and ($T_{\lambda\mu\nu\rho}$) antisymmetric in neighbouring suffixes. The interaction terms, arising from the interaction between the field and the sources, suggest the interaction which occurs between the field and polarization in the electromagnetic theory of polarizable media. This analogy is studied and an expression for the energy tensor is derived. The field components are determined by the polarization tensors and vectors. L. S. G.

530.145.1 2035

Derivation of Dirac's equation for a free particle. CHENG, K. C. *Proc. Camb. Phil. Soc.*, **42**, 185–7 (*June*, 1946).—It is shown that the equation may be obtained from quantum mechanics alone if the relativistic energy of the particle is treated as an energy operator. L. S. G.

530.145.1 : 531.314.3 2036

A note on the Hamiltonian equations of motion. CHANG, T. S. *Proc. Camb. Phil. Soc.*, **42**, 132–8 (*June*, 1946).—If the Lagrangian, L, contains only the field observables and their first derivatives, the field equations, obtained by varying the Lagrangian, may be brought into canonical form and thus quantized by introducing suitable commutation relations. A study is now made of the case where L contains derivatives higher than the first. With proper definitions of the conjugate variables and of the Hamiltonian the field equations can in most cases be brought into canonical form. A modified form is given when the conjugate variables are independent. A special case, suggested by the Lagrangian for a Dirac electron, is discussed. L. S. G.

530.145.6 = 4 2037

On the wave mechanics of elementary particles. KWAL, B. *C.R. Acad. Sci., Paris*, **218**, 613–15 (*April* 12, 1944) *In French.*—A continuation of a previous note [Abstr. 1506 (1946)]. The secondary equations are now studied. Those for a spin $j = 1$ and $j = \frac{3}{2}$ are given explicitly and the form for general values of j is indicated. L. S. G.

530.145.6 : 537.12 = 4 2038

The specific charge and the spin of the classical electron. STUECKELBERG, E. C. G. *Helv. Phys. Acta.*, **18** (*No.* 1) 21–44 (1945) *In French.*—The linear electrodynamical theory of the electron, given in two previous papers [Abstr. 1342 (1944)], is now replaced by a theory in which the field equations may be non-linear. It is then possible to introduce the theory of gravitation. The results are: (1) the gravitational charge of the complete system is the same as its inertial mass, (2) the functional equation for the world line of the electron possesses, for certain non-linear theories of a highly singular form, periodic solutions, even in the absence of an incident field of radiation. In this theory an acceleration of charged particles without radiation is possible. L. S. G.

MECHANICS OF SOLIDS 531

531.18 : 530.12 2039

A note on the relativistic problem of uniform rotation. HILL, E. L. *Phys. Rev.*, **69**, 488–91 (*May* 1 *and* 15, 1946).—A study of uniform rotational motion about an axis is made on the basis of a definition of hydrokinetic character. A solution is found in which the particle speed is linear with distance from the axis of rotation to terms in $(R\omega_0/c)^2$, but approaches the speed of light at great distances. This result is unchanged by the introduction of relativistic accelerated Euclidean axes. Reasons are given for concluding that Ehrenfest's paradox in the problem of the rotating disc and the question of the "geometry" of the motion, in the sense of general relativity theory, can be answered only on the basis of a theory of the generation of the rotation.

531.18 : 530.12 2040

Relativistic dynamics of spin-fluids and spin-particles. WEYSSENHOFF, J. W. *Nature, Lond.*, **157**, 766–7 (*June* 8, 1946).

531.18 : 530.12 2041

Spin-particles moving with the velocity of light. WEYSSENHOFF, J. W. *Nature, Lond.*, **157**, 767 (*June* 8, 1946).

531.19 = 4 2042

Distribution law for summation functions in statistical mechanics. KHINTCHINE, A. *C.R. Acad. Sci., URSS*, **34** (*No.* 2) 55–7 (1942) *In French.*—It was previously shown that the classical limit theorems of the calculus of probabilities may be used to derive

asymptotic formulae for the mean values and dispersions of summation functions, which are the most important functions of statistical mechanics. The law of distribution for such functions is now deduced. It is of the Gaussian form. The dispersion is also found. L. S. G.

531.19 : 532.7 : 533.7 2043

The statistical mechanical theory of transport processes. I. General theory. KIRKWOOD, J. G. *J. Chem. Phys.*, **14**, 180–201 (*March*, 1946).—Outlines are sketched for a general statistical mechanical theory of transport processes; e.g. diffusion, heat transfer, fluid flow and response to time-dependent external force fields. In the case of gases the theory leads to the Maxwell–Boltzmann integro-differential equation of transport. In the case of liquids and solutions, it leads to a generalized theory of Brownian motion, in which the friction constant is explicitly related to the intermolecular forces acting in the system.

531.261 = 4 2044

Solution of an inverse problem in the theory of potential. ZAMOREFF, A. A. *C.R. Acad. Sci., URSS*, **32** (*No.* 8) 546–7 (1941) *In French.*—A continuation of previous work [*C.R. Acad. Sci., URSS*, **31** (*No.* 9) (1941)]. It is now shown that if, on a certain line, the derivative of the potential due to a heavy body be known, the shape and density of the body may be determined. L. S. G.

531.314.3 : 530.145.1 *see Abstr.* 2036

531.391.1 : 512.83 *see Abstr.* 2007

531.51 : 530.12 : 523.11 = 3 *see Abstr.* 2016

MECHANICAL MEASUREMENTS 531.7

531.711 = 4 2045

The new graduated prototype of the International Bureau of Weights and Measures for the subdivisions of the metre. MOREAU, H., AND CABRERA, N. *Rev. Opt. (Théor. Instrum.)* **23**, 255–60 (*Oct.–Dec.*, 1944) *In French.*—The difficulties originally encountered in working with Pt–Ir (poor polish, difficulty in marking, etc.) meant that some of the older prototypes were not entirely satisfactory. One of these (T_4) has now been renovated, markings removed, surface planed and repolished, and regraduated. Two independent examinations have now been made of this new prototype and it is found that the error for any graduation rarely exceeds a micron. The length is given as 1 m $-$ 1·14 μ at 0°C. A. H.

531.717.86 : 535.423 2046

A method for precision alignments. VAN HEEL, A. C. S. *J. Opt. Soc. Amer.*, **36**, 242–3 (*April*, 1946).—In aligning three points, one point being midway between two end points separated by 30 to 50 m, an attempt was made to use the diffraction max. and min. on the outside of the geometrical shadow of a straight edge. A precision of the order of 0·1 mm was thus obtained. A second attempt substituted a double slit for the straight edge and in this case a precision of the order of 0·01 mm was obtained. The suggestion is made that the method could be used for the determination of the deviations of machine parts, lathe beds, etc. A. H.

531.776 2047

Measurement of high rotational speed. MAJUMDAR, S. D. *Indian J. Phys.*, **28**, 153–8 (*Aug.*, 1945).—The method is an application of the stroboscopic principle. Intermittent light from a mirror on an electrically maintained tuning fork passes through a narrow slit and is reflected from a slightly tilted mirror fixed to the centrifuge; a circle of bright dots appears on a screen. The number of these dots is equal to the denominator of the ratio of the frequency of rotation to that of vibration. To obtain the numerator the slit is moved a little, and each dot splits up into two which again coincide. The displacement of the slit from the zero position necessary to get this coincidence is measured, and from this the numerator is calculated. The method is capable of a very high degree of accuracy.

531.788.12 = 4 2048

McLeod gauge improvements. TARBÈS, P. *Le Vide*, **1**, 9–11 (*Jan.*, 1946) *In French.*—Relates to gauges with fixed compression ratios. The Dunoyer modification, with four ratios, necessitates four reading tubes of different diameters to eliminate the effects of capillarity in determining the pressure differences. The improvement described consists of using only one tube and correcting for capillarity by moving the zero of the scale on which the magnified pressure difference is read. The amount of this correction is determined by a separate calibration which requires frequent repetition, as it depends on the state of the glass walls of the tube. N. C.

531.788.6 2049

Thermocouple vacuum gage. ROBINSON, H., AND FLANAGAN, M. C. *Gen. Elect. Rev.*, **49**, 42–4 (*May*, 1946).—Utilizes variation of thermal conductivity of gas with pressure at low temperatures. A standard heating current is passed through a wire in the gas, and the equilibrium temperature of the wire measured by a thermocouple, connected mechanically but not electrically to the wire. The higher the pressure, the higher the conductivity of the gas and the lower the thermocouple reading. The instrument covers the range 0–200 microns, is direct-reading and may be used to give remote indications. By comparison of readings with those of a McLeod gauge, the partial pressure of condensible gases may be estimated. N. C.

531.788.7 2050

An ionization gauge of simple construction. FOGEL, C. M. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 302–5 (*May*, 1946).—A new gauge is described for measuring pressures from 10^{-4} to $<10^{-8}$ mm of Hg. Except for a multiplying factor of 10, it gives a direct reading of residual air pressure. The gauge employs two plates, as the electron and ion collector, respectively. They are located on opposite sides of the filament, but equidistant from it. This allows easy outgassing of parts, either by electron bombardment or by r.f. heating. A protective shield in front of the ion collector aids in reducing the electrical leakage to that element.

531.788.7 : 621.316.71 2051

A reliable high vacuum gauge and control system. PICARD, R. G., SMITH, P. C., AND ZOLLERS, S. M. *Rev. Sci. Instrum.*, **17**, 125–9 (*April*, 1946).—Two

gauges are employed, one a thermocouple and the other a discharge gauge. The instrument is extremely satisfactory for the measurement of pressures in the range, atmospheric to $<10^{-4}$ mm Hg. Both gauges are of a type which will not be damaged if gases are suddenly admitted to the system. The gauges and power supply are described in detail. A circuit is given whereby the current from the gauges may be used to control equipment so that the pressure in the vacuum system may be used to operate other devices.

MECHANICS OF LIQUIDS 532

532.526 : 536.24.01 2052

Calculations concerning theoretical values of boundary-layer thickness and coefficients of friction and of heat transfer for steady two-dimensional laminar flow in an incompressible boundary layer with mainstream velocity $U \propto x^m$ or $U \propto e^{ax}$. OLDROYD, J. G. *Phil. Mag.*, **36**, 587–600 (*Sept.*, 1945).—The boundary layer thicknesses and the coefficients of friction are determined by two methods: (1) from data given by Hartree's numerical solution of the boundary layer equations [Abstr. 2389 (1937)]; (2) Pohlhausen's adaptation of the momentum equation. The results give an indication of the accuracy of method (2). Discrepancies are small when the pressure gradient is negative. The coefficients of heat transfer (C_H) and skin-friction (C_f) are compared for a range of values of the Prandtl number, σ. It is found that a law of the form $C_H/\frac{1}{2}C_f = A\sigma^n$ may be expected to give good results especially when $0{\cdot}6 \leqslant \sigma \leqslant 7{\cdot}0$. The values of A and n for different forms of the mainstream velocity are given. L. S. G.

532.64 : 541.183.02 2053

Saturated adsorbed films and the structure of deeply super-cooled water. BANGHAM, D. H. *Nature, Lond.*, **157**, 733 (*June* 1, 1946).—The reported spreading of super-cooled water drops at low temperatures [Abstr. 1613 (1946)] does not imply a lowering of surface tension, but rather that the molecular pattern of the water, and specially its surface layer, approximates more closely to that of the adsorbed vapour films on the metal surface. [See Abstr. 1859 (1938)].

532.7 : 533.7 : 531.19 *see Abstr.* 2043

532.7 : 539.6 = 4 2054

Process of calculating some molecular magnitudes of the liquid state. MÉRIGOUX, R. *C.R. Acad. Sci., Paris*, **222**, 138–9 (*Jan.* 7, 1946) *In French.*—On the assumption that the force of molecular interaction is of the form $f(r) = a(r - r_0)/r^k$, expressions are found for a, r_0 and k in terms of observable quantities. A. J. C. W.

532.72 2055

The diffusion of electrolytes and macromolecules in solution: A historical survey. LONGSWORTH, L. G. *Ann. N.Y. Acad. Sci.*, **46**, 211–39 (*Nov.* 30, 1945).—This historical survey is an introduction to a monograph on diffusion which contains the 5 papers which follow [Abstr. 2055–60 (1946)]. Its justification is to fill in gaps left by the other authors and to emphasize experimental methods. The subjects dealt with are: Fick's laws of diffusion; boundary conditions in diffusion; integral and differential diffusion coefficients; Boltzmann's relation; the theoretical interpretation of the diffusion coefficient; and experimental methods which include: layer analysis, the float method, optical and micro-methods, precision of the optical methods, and the steady state method of Clack. The last named has been discussed at some length because Clack's results were found by Onsager and Fuoss to be most nearly in accord with the theory of the process, and of particular interest to those primarily interested in the optical methods. The difficulties attendant upon the development and maintenance of the steady state have made Clack's work an outstanding contribution to our knowledge of diffusion. H. H. HO.

532.72 2056

Theories and problems of liquid diffusion. ONSAGER, L. *Ann. N.Y. Acad. Sci.*, **46**, 241–65 (*Nov.* 30, 1945).—After an introduction which indicates the relative lack of development of the theory of liquid diffusion, the author considers systems of description since not one of the phenomenological schemes which are fit to describe the general case of diffusion is widely known. The treatment includes the generalization of Fick's law, reciprocal relations, the dissipation-function, and diffusion and hydrodynamics. The diffusion of non-electrolytes is next discussed for dilute and concentrated solutions, following which comes the consideration of solutions of electrolytes based on a comprehensive analysis of kinetic and colligative properties such as diffusion and electrolytic conduction, and the effects of Coulomb forces. A brief note on concentrated solutions of electrolytes concludes the paper. H. H. HO.

532.72 : 541.64 2057

The effects of concentration and polydispersity on the diffusion coefficients of high polymers. BECKMANN, C. O., AND ROSENBERG, J. L. *Ann. N.Y. Acad. Sci.*, **46**, 329–45 (*Nov.* 30, 1945).—Lamm has shown that there are many advantages to be realized by transforming the experimental data obtained at various times of diffusion to a set of normal co-ordinates which eliminate time, diffusion coefficients, concentration and geometry of optical system as variables. In such co-ordinates, the experimental points obtained at different times will all fall on the same curve for a perfect experiment. By this device, a sensitive test is afforded for the reliability of data obtained at different times of diffusion, and an ideal diffusion curve has been derived, which is compared with curves from experimental data afforded by three amylose acetates. The effects of polydispersity on the diffusion coefficients of high polymers are then discussed, and tests for polydispersity indicated, e.g. by comparing the results of a free diffusion with those of an ultracentrifugal experiment. H. H. HO.

532.72.08 2058

A conductance method for the determination of the diffusion coefficients of electrolytes. HARNED, H. S., AND FRENCH, D. M. *Ann. N.Y. Acad. Sci.*, **46**, 267–81 (*Nov.* 30, 1945).—The apparatus measures the differences in conductance across the top and bottom of a cell of the form of a rectangular parallelepiped, while the electrolyte is diffusing vertically upward. The theory of the cell is developed, and both the theoretical and practical advantages of employing a difference in conductance rather than a

single conductance measurement are shown. In addition to the conductance measurements at suitable time intervals, only the depth of the cell is required for the absolute determination of the diffusion coefficient. Measurements of the diffusion coefficient of KCl solutions at 25°c and in the concentration range 0·0025-0·005M have been made. These are compared with theoretical values derived from the theory of Onsager and Fuoss, and the error appears to be approximately ±0·9%. H. H. HO.

532.72.08 2059

The diaphragm cell method of measuring diffusion. GORDON, A. R. *Ann. N.Y. Acad. Sci.*, **46**, 285–308 (*Nov.* 30, 1945).—Northrop and Anson's diaphragm cell is first described with various modifications of experimental technique, together with a derivation of the equation, $\ln \Delta c_f/\Delta c_0 = -\beta Dt$, usually employed to compute the diffusion coefficient in a diaphragm cell measurement, where Δc_f and Δc_0 stand for final and initial concentration differences, β is the cell factor, and D is the diffusion coefficient. It is assumed implicitly that the cell factor remains constant, i.e. that both solutions are constant in volume. The present paper is devoted to a consideration of the validity of the above equation in interpreting cell data. The questions of cell volume, homogeneity of the inner and outer solutions, the assumption of a steady state in the diaphragm, the mechanism of transport in the diaphragm, the calibration of the diaphragm cell and the relation between the diaphragm cell integral coefficient and the differential coefficient are reviewed in this connection. It is concluded that the cell is still unsurpassed in its simplicity and in the precision of the data it yields. H. H. HO.

532.72.08 2060

Diffusion constant measurement in theory and practice. BEVILACQUA, E. M., BEVILACQUA, E. B., BENDER, M. M., AND WILLIAMS, J. W. *Ann. N.Y. Acad. Sci.*, **46**, 309–27 (*Nov.* 30, 1945).—A review of theory indicates that there is little justification for modification of the present methods of calculation of diffusion constants in order to account for symmetrical deviations from the normal (Gauss) curve. For asymmetrical deviations, the type of calculation developed by Beckmann and Rosenberg may be used if a solvent cannot be found in which the solute shows ideal behaviour. A review of selected diffusion constant data is then given to illustrate some of the theoretical points raised, and this includes results afforded by proteins and derived substances, polysaccharides, cellulose and cellulose derivatives, and by sodium lauryl sulphate. H. H. HO.

MECHANICS OF GASES 533

533.15 : 539.155.2 *see Abstr.* 2147

533.5 : 666.1.037.5 : 669.278 *see Abstr.* 2211

533.7 : 532.7 : 531.19 *see Abstr.* 2043

533.72 2061

Heat-capacity lag in gas dynamics. KANTROWITZ, A. *J. Chem. Phys.*, **14**, 150–64 (*March*, 1946).—The existence of energy dissipations in gas dynamics, which must be attributed to a lag in the vibrational heat capacity of the gas, has been established both theoretically and experimentally. A general theory of the dissipations in a general flow problem is developed and applied to some special cases. Energy dissipations due to this effect are to be anticipated in turbines; they might also introduce errors when the flow of one gas is used to simulate the flow of another. Unfortunately, the relaxation times of most of the gases of engineering importance have not been studied. A new method of measuring the relaxation time of gases is introduced in which the total-head defects observed with a specially shaped impact tube are compared with theoretical considerations. A parameter is thus evaluated in which the only unknown quantity is the relaxation time of the gas. This method has been applied to CO_2 and has given consistent results for two impact tubes at a variety of gas velocities.

533.74 : 548.7 *see Abstr.* 2183

533.75 : 523.877 : 537.562 2062

On the equation of state of ionized hydrogen. WILLIAMSON, R. E. *Astrophys. J.*, **103**, 139–44 (*March*, 1946).—The electrostatic correction to the equation of state is calculated from the virial theorem, using the Debye–Hückel law of distribution of charge round a given charge. The fractional correction to the pressure is $-0{\cdot}014[(\rho/100)/(T/10^7)^3]^{\frac{1}{2}}$. T. G. C.

ACOUSTICS . VIBRATIONS 534

534.133 : 537.228.1 = 3 2063

Effect of a linear inhomogeneity in the external alternating field on the excitation of a quartz rod. NIESSEN, K. F. *Physica, 's Grav.*, **8**, 695–702 (*July*, 1941) *In German.*—Laue has shown that a homogeneous alternating field applied parallel to a two-fold axis of a quartz rod cut parallel to the three-fold axis produces oscillations for which the centre of the rod is a node, and at resonance the ends of the rods are antinodes. The resonant frequencies are proportional to odd integers. If the amplitude of the field increases linearly along the rod the centre is not necessarily a node, and resonant modes can be excited for which the centre is an antinode. These resonant frequencies are proportional to even integers. Expressions are derived for the amplitude of the oscillations in terms of the dimensions of the rod, frequency, piezoelectric and elastic moduli, and damping. The results are extended qualitatively to quartz plates and it is suggested that one plane and one cup-shaped electrode would produce the necessary inhomogeneous field. A. J. C. W.

534.222.1 2064

The wave equation in a medium with variable index of refraction. BERGMANN, P. G. *J. Acoust. Soc. Amer.*, **17**, 329–33 (*April*, 1946).—The paper deals theoretically with the effects of density gradients in the atmosphere or in large bodies of water on the propagation of sound waves. It is found that the gradient of hydrostatic pressure in water is comparable in effect with a temperature gradient of 0·1°F/100 ft. This is negligible if the temperature gradient appreciably exceeds that value. Similar considerations can be applied to the case of sound in air. It is concluded that gravity terms can be

disregarded except in certain extreme cases, e.g. at very low frequencies. A. B. W.

534.222.2 2065

Some properties of very intense shock waves. SACHS, R. G. *Phys. Rev.*, **69**, 514–22 (*May* 1 *and* 15, 1946).—Conditions have been obtained for the existence of a steady shock wave of such an intensity that radiation pressure plays a role in determining the properties of the shock. These conditions are completely analogous to the Rankine–Hugoniot equations for ordinary shocks; they are obtained by consideration of the conservation of mass, momentum and energy. The results are applied to hydrogen and other very light gases. The application to other media requires a much more complicated discussion of the equation of state and sp.ht. under extremely high pressures and temperatures. In the light gases, the thickness of the shock front is extremely large because the radiation free path, which is determined by Compton scattering, is also large. The velocity of sound in a medium under very high pressures and temperatures is also discussed, and it is found that this velocity continues to increase with increasing pressure, a condition that is necessary for the shock to be stable.

534.37 = 3 2066

Theory of thermal damping in solids. PÄSLER, M. *Z. Phys.*, **122**, 357–86 (1944) *In German.*—In order to calculate the thermal damping in solids the equation of motion of the oscillators is determined by applications of the Hamilton principle. The potential energy of the oscillator used in the calculation is replaced by a term involving thermal properties. This leads to an extended equation of motion for the oscillators, in which a damping term occurs, so that the thermal damping can be obtained from the logarithmic decrement. The thermal damping for bodies of different forms (rod, plate, sphere, cylinder) is calculated. B. A.

534.852 : 621.395.625.2 2067

Phonograph reproducer design. BACHMAN, W. S. *Trans. Amer. Inst. Elect. Engrs*, **65**, 159–62 (*March*, 1946).—[Abstr. 1903 B (1946)].

OPTICS . RADIATION . SPECTRA 535

535.14 = 3 2068

New method for quantizing free radiation: neutrino theory of light. BOLLERT, K. *Z. Phys.*, **122**, 98–119 (1944) *In German.*—The usual quantization of free radiation is considered, and difficulties arising are traced to the conditions of quantization of the Maxwell equations. Double equations combining the quantum-mechanical laws of motion with the Maxwell equations are obtained for the field vectors. The results of this method of approach are compared with older theories. The neutrino theory of light, as stated by Kronig and Jordan, is shown to be a direct mathematical consequence of the quantization of free radiation. B. A.

535.14 : 530.145 = 4 *see Abstr.* 2033

535.231.4 2069

Infra-red emissivity of metals at high temperatures. PRICE, D. J. *Nature, Lond.*, **157**, 765 (*June* 8, 1946).—Measurements have been made on Fe and Pt from which the temperature coefficients of emissivity at various wavelengths have been determined. These show a transition between the Hagen–Rubens value at long wavelengths to a zero value at a specific wavelength (0·93 μ for Pt, 1·0–1·5 μ for Fe).

535.241.48 : 535.371 *see Abstr.* 2094

535.242.2 : 535.37.08 = 4 *see Abstr.* 2092

535.245.24 : 628.972 2070

Light flux distribution in a rectangular parallelepiped and its simplifying scale. HISANO, K. *Illum. Engng, N.Y.*, **41**, 232–47 (*March*, 1946).—A theoretical and practical discussion of the flux distribution within a parallelepiped with diffusing sides. It is shown that the calculation of the illumination can be simplified by using the conception of a square room of "equivalent height" z, equal to $h(a + b)/2ab$ where h is the actual height and a and b are the lengths of the actual sides. The treatment is applicable where $z \leqslant 2$ and $b/a \leqslant 4$. J. W. T. W.

535.3 : 548.73 : 537.531 = 3 *see Abstr.* 2123

535.313 : 535.87 : 771.35 = 4 2071

On a particular class of mirror objectives. PAUL, M. *Rev. Opt.* (*Théor. Instrum.*) **23**, 277–84 (*Oct.–Dec.*, 1944) *In French.*—Discusses the reduction in spherical and chromatic aberration obtained by using photographic objectives composed of reflectors. The high luminosity obtained is emphasized, together with the advantages this gives in cinephotography. The ideas outlined are applied to triplets of the Taylor type. A. H.

535.317.6 : 535.42 = 4 2072

Geometrical aberration and the Rayleigh limit. MARÉCHAL, A. *Comm. Lab. Inst. Opt. Paris*, 60–7 (*July*, 1944) *In French.*—Rayleigh's rule is applied to the calculation of the permissible tolerances in the following cases: focusing of optical instruments, spherical aberration of the third order, corrected spherical aberration, coma, and astigmatism. A table is given, showing the extent to which these defects can be present without affecting the final image. N. C.

535.317.6 : 535.824.2 2073

The trigonometrical correction of microscope objectives. CRUICKSHANK, F. D. *J. Opt. Soc. Amer.*, **36**, 296–8 (*May*, 1946).—The general method of differential correction of an optical system developed earlier [Abstr. 2874, 2876 (1945)] is adapted to the particular problem of the trigonometrical correction of a microscope objective. Transfer coefficients are introduced which specify the rate of change of the spherical aberration, the zonal chromatic aberration, the departure from the sine condition, the numerical aperture and the working distance with the constructional parameters of the system. A numerical example of the correction of a Lister type objective is given.

535.33.08 : 537.521 2074

Spectral intensity measurements with photo-tubes and the oscillograph. DIEKE, G. H., LOH, H. Y., AND CROSSWHITE, H. M. *J. Opt. Soc. Amer.*, **36**, 185–91 (*April*, 1946).—Where spectroscopic sources are running on a.c. and it is desired to follow intensity variations, then measurements are necessary which

are of a duration short compared with the length of a cycle. These measurements are made by feeding the output of a photo-multiplier tube into a cathode-ray oscillograph. The general procedure is here described and some typical results given. Under favourable circumstances intervals of about 10^{-7} sec are possible and no difficulty is obtained in getting a resolving power of 1 μsec. Care is necessary in selecting the phototube. The behaviour of discharge tubes, sparks and d.c. arcs is examined by means of the set-up. A. H.

535.331 = 3 2075

Structure of the spectrum of singly-ionized thorium. II. DE BRUIN, T. L., KLINKENBERG, P. F. A., AND SCHUURMANS, P. *Z. Phys.*, **122**, 23–35 (1944) *In German.*—The observed terms of the *B* system of the Th II spectrum are given, and the terms of the lower group are identified. The $6d^2 7s$ and $6d^3$ configurations are widely separated. The positions of the ds^2, d^2s and d^3 terms are compared with those of the corresponding terms of the Hf II and Zr II spectra. There are well-marked distortions in the Th II spectrum, and comparison of the *g* values of the corresponding terms of the La I, Hf II and Th II spectra for *L–S* coupling shows that there are some abnormal values in the case of Th II, particularly with the $ds^2\ ^2D_{3/2}$ and $d^2s\ ^4F_{3/2}$ terms. Multiplets were observed for the $6d\ 7p\ 7s$ and $6d^2\ 7p$ configurations. The last line of the spectrum is at λ2837·31 Å, the transition being $6d^2 7p\ ^4G_{11/2} \rightarrow 6d^2 7s\ ^4F_{9/2}$. The ground-term of the *B* system is somewhat lower than that of the *A* system. B. A.

535.338 = 3 2076

Continuous retardation and recombination radiation of electrons in the gas discharge column. HAHN, O. T., AND FINKELNBURG, W. *Z. Phys.*, **122**, 36–48 (1944) *In German.*—The continuous spectrum of a high current-density discharge in gases can be regarded as retardation and recombination radiation of electrons. This hypothesis has been tested electrically and optically with condenser-capillary discharges in H_2, N_2, O_2, He and CO_2 between 2 and 105 mm pressure. At 770 kA/cm² the radiation intensity increases with (current density)², as would be expected from theory. The hypothesis also requires that the continuous spectrum should be unaffected by the individual properties of the gas, and experiment shows that, within the accuracy of the measurements, the intensity does not vary with frequency in the whole visible spectral range. B. A.

535.338.4 2077

Note on the emission bands of the silver iodide molecule. SASTRY, C. R., AND RAO, K. R. *Indian J. Phys.*, **28**, 136–7 (*Aug.*, 1945).—The complete band system was obtained using a high frequency oscillatory electrodeless discharge in the vapour, contained in a quartz tube. The stronger bands form the progression (*o*, *v''*). The intensity distribution of these bands in emission is compared with that in absorption and fluorescence.

535.338.4 2078

Predissociations in nitric oxide. FLORY, P. J., AND JOHNSTON, H. L. *J. Chem. Phys.*, **14**, 212–13 (*March*, 1946).—The authors' reply to criticism by Gaydon [Abstr. 1793 (1944)].

535.339.1 = 4 2079

Focussing of monochromators. VODAR, B. *Rev. Opt. (Théor. Instrum.)* **21**, 97–113 (1942) *In French.*—It is shown that theoretical work by Hartmann leads to a very simple construction for a monochromator with autocollimating prism, or for a double monochromator, which offers many advantages, especially for the ultra-violet region. A simple mechanical coupling controls the rotation of the prism and the displacement of the lens and gives practically perfect focusing. Other types of monochromators are discussed and methods of focusing and astigmatism considered. A. H.

535.341 : 535.81 = 4 2080

Direct measurement of absorption factor of optical glasses. MARÉCHAL, A. *Comm. Lab. Inst. Opt. Paris*, 120–4 (*Dec.*, 1944) *In French.*—As surface reflections may be greatly reduced by modern techniques, loss of light by absorption in the glass itself becomes more important. There is therefore a need for an accurate method for determination of absorption factors. By finding the reflection factor of a plane metal mirror, and then placing the plate glass in front and measuring the overall reflection factor of the system, it is possible to calculate the absorption of the glass separately from the reflection at the surfaces. N. C.

535.343 : 523.872 *see Abstr.* 2025

535.343–15 2081

Motions of molecules in condensed systems. II. The infra-red spectra for benzene solid, liquid, and vapor in the range from 3 to 16·7 μ. HALFORD, R. S., AND SCHAEFFER, O. A. *J. Chem. Phys.*, **14**, 141–9 (*March*, 1946).—Infra-red spectra are compared throughout the interval from 600 to 3 300 wave numbers for the same amount of benzene existing separately as solid at 3°, liquid at 8° and vapour at 20°C. The comparison demonstrates convincingly that (1) predictable selection rules for the solid are obeyed strictly, (2) there are no selection rules operating in the liquid phase, (3) the shift of molecular frequencies induced by successive stages of condensation is small and can be ignored in the approximation that regards the vibrations of an isolated molecule as harmonic ones, (4) the intensification of components of the spectrum accompanying changes of state proceeds as predicted qualitatively in an earlier paper [Abstr. 1295 (1946)], (5) all proposed complete assignments of the fundamental frequencies of benzene require revision. The components appearing in the several spectra are classified in accordance with a scheme suggested by the selection rules for the vapour and solid.

535.343–15 : 535.375.5 : 539.132 = 4 2082

Vibration frequencies of the halogen derivatives of methane from infra-red and Raman spectra. LECOMTE, J. *Ann. Phys., Paris*, **15**, 258–83 (*April–June*, 1941) *In French.*—The infra-red and Raman data for the various halogen derivatives of methane ($CX_4 \rightarrow CH_4$ where X = halogen) are collected, and a systematic study is made of the variations in the positions of the bands as the number and atomic weights of the substituent atoms are changed. The various frequencies of vibration of the molecule are identified, a classification being obtained which satisfies all of

the experimental results. Some general conclusions are reached concerning the frequency displacements obtained on passing through various stages of substitution. A. H.

535.343–15 : 539.13 = 4 2083

Interpretation of the infra-red absorption spectra of thiophene and some of its derivatives. Molecular symmetry of thiophene, furane and pyrrol. GARACH, J., AND LECOMTE, J. *C.R. Acad. Sci., Paris*, **222**, 74–6 (*Jan.* 2, 1946) *In French.*—The spectra have been studied over the range 525–1 700 cm^{-1}. It is pointed out that there are certain discrepancies between the Raman and infra-red results and possible reasons for this are discussed. A. H.

535.343.3–15 : 535.375.5 = 4 2084

Infra-red absorption spectra of some halide derivatives of benzene. PAJEAU, R., AND LECOMTE, J. *C.R. Acad. Sci., Paris*, **222**, 76–7 (*Jan.* 2, 1946) *In French.*—About a dozen spectra have been examined from 500 to 1 350 cm^{-1} and in some cases Raman spectra have also been obtained. A study is made of the variation in the spectrum with the weight and position of the substituting group. A. H.

535.343.4 : 551.521.3 = 4 *see Abstr.* 2195

535.343.4–31 2085

Absorption spectrum of fluorbenzene in the near ultraviolet. WOLLMAN, S. H. *J. Chem. Phys.*, **14**, 123–30 (*March*, 1946).—The absorption spectrum of C_6H_5F at 2 750–2 380 Å was photographed in the 1st order of a 3-meter grating spectrograph. As in C_6H_5Cl the band system corresponds to an electronic transition A_1, B_1. This is an allowed transition and the 0,0 band is stronger than in C_6H_5Cl because of the greater perturbation by the fluorine. Several progressions of totally symmetric vibrations are observed. The vibration whose excitation brings the corresponding benzene spectrum into appearance, and which shows up relatively intensely in C_6H_5Cl, appears in C_6H_5F but is not particularly prominent. In contrast to C_6H_5Cl, transitions to the carbon-halogen vibration in the upper electronic state are quite strong.

535.345.1 : 535.39 : 614.485 2086

Transmittance and reflectance of germicidal (λ2537) energy. LUCKIESH, M., AND TAYLOR, A. H. *J. Opt. Soc. Amer.*, **36**, 227–34 (*April*, 1946).—Describes apparatus for measuring the transmission factor of liquids for energy of wavelength 253·7 mμ. The transmitted energy irradiates a plate of Zn silicate phosphor and the brightness is measured with a photocell. A reflectometer for measuring reflection factors of surfaces at the same wavelength is also described. Curves of spectral reflectance between 250 and 435 mμ are given for stainless steel, Ni, Cr, Ag and variously treated Al surfaces. J. W. T. W.

535.345.1 : 539.23 = 3 2087

Transparency of amorphous selenium. BECKER, A., AND SCHAPER, I. *Z. Phys.*, **122**, 49–61 (1944) *In German.*—The transparency of red amorphous Se, produced by cathodic sputtering, has been determined for various thicknesses in the visible and in the near infra-red, from −150 to 150°C. Variations of thickness and structural differences in the same specimen make it difficult to obtain accurate results, but the transparency is greater for shorter λ, the effect being the more marked the lower the temperature. The photo-electric sensitivity is max. where the light absorption is min. The fall of the primary current towards shorter λ is parallel to the decrease of transparency, but there is no connection in the case of the longer λ. The structure of Se films is discussed in relation to their transparency. B. A.

535.347 = 4 2088

Contribution to the study of molecular dichroism. NIKITINE, S. *Ann. Phys., Paris*, **15**, 284–348 (*April–June*, 1941) *In French.*—A survey is made of the underlying theory, methods of measurement, etc., of the anisotropic absorption of light by dye molecules. The molecules studied are cyanine, eosine and pinacyanol. Close agreement is found between the theory developed and the experimental results obtained. A. H.

535.36 : 535.81 = 4 *see Abstr.* 2108

535.36 : 538.61 = 4 2089

Depolarization of the diffuse radiation near optical resonance by a magnetic field. LENNUIER, R. *C.R. Acad. Sci., Paris*, **222**, 77–9 (*Jan.* 2, 1946) *In French.*—Mathematical development of the relation between P and H. An earlier approximate relation is replaced by a rigorous one and excellent agreement with experimental results is claimed. A. H.

535.37 = 4 2090

Distribution of spectral energy in some cases of photoluminescence. SERVIGNE, M., AND VASSY, E. *Rev. Opt. (Théor. Instrum.)* **21**, 88–96 (1942) *In French.*—A study is made of various synthetic minerals, silicates and tungstates, obtained by crystallization at high temperature. These are deposited on the inner surface of a glass tube filled with a mixture of A and Hg vapour which is excited by a current of 25 mA at 150 V. The radiations are compared spectrographically with that from a tungsten lamp and the curves obtained for the various substances are given. A. H.

535.37 : 551.593 = 4 2091

Increased intensity of the yellow ray of the night sky. ABABIE, P., VASSY, E., AND VASSY, E. *C.R. Acad. Sci., Paris*, **222**, 99–100 (*Jan.* 2, 1946) *In French.*

535.37.08 : 535.242.2 = 4 2092

Photometry of phosphorescent substances. CLARA, J. *Rev. Opt. (Théor. Instrum.)* **21**, 128–31 (1942) *In French.*—After surveying some uses of phosphorescent materials, a photometric apparatus is described suitable for studying the variation of intensity of the radiation with length of time after cessation of excitation. A translucent screen is placed in the same plane as the sheet of phosphorescent material and illuminated from behind by a lamp whose light passes through a filter so as to match up the colours of the two sheets. The lamp distance is varied and the time for the two screens to reach equality is measured. Knowing the constants of the apparatus the relative distances can be converted into relative intensities and thus a time-intensity curve obtained for the material. A. H.

535.371 2093

Light sum of phosphors under thermal and infra-red stimulation. ELLICKSON, R. T. *J. Opt. Soc. Amer.*,

36, 264–9 (*May*, 1946).—The experiments reported deal with the recently discovered type of phosphor that shows a large amount of luminescence of visible light when irradiated with infra-red. The emission can be made to occur when the normal phosphorescence has decayed to a negligible value. The light sum, or area under the decay curve, of such phosphors under infra-red stimulation is of the order of 1 000 microlambert minutes. Measurements are reported for the light sum when the sample is irradiated with infra-red and when it is heated. In some phosphors the infra-red light sum is 15–30× as great as the light sum obtained by heating. In others, it is about the same, or perhaps even less. Attention is called to the connection between these experiments and the "glow curve" experiments used to determine the distribution of electron traps in phosphors.

535.371 : 535.241.48 2094

The effect of wave-length distribution on the brightness of phosphors. ELLICKSON, R. T. *J. Opt. Soc. Amer.*, **36**, 261–4 (*May*, 1946).—The visual efficiency of a phosphor may be defined as the visual response produced by the phosphor per quantum of emitted light divided by the visual response per quantum at the maximum of the visibility curve for the eye. An expression is derived, valid for phosphors with an emission curve that can be represented by a Gauss error function. Curves are given for the visual efficiency of a phosphor, given the peak wavelength and ½-width of its emission curve. When the peak of the emission curve is separated from the peak of the visibility curve by more than a critical value of about 400 Å, there is a value of the ½-width of the emission curve different from zero for which the visual efficiency is a maximum.

535.371 : 541.127.1 *see Abstr.* 2173

535.371 = 4 2095

Inhibiting effect exercised by oxygen on the fluorescence of solutions. CHÉCHAN, C. *C.R. Acad. Sci., Paris*, **222**, 80–2 (*Jan.* 2, 1946) *In French.*—A comparison is made of the fluorescence exhibited by solutions when saturated with oxygen and when no oxygen is present. It is found that the presence of oxygen always weakens the fluorescence but that the diminution varies with the fluorescing substance and with the solvent. The effect is particularly marked when the solvent has a low permittivity. A. H.

535.372 2096

Resonance spectrum of iodine. RANK, D. H. *J. Opt. Soc. Amer.*, **36**, 239–41 (*April*, 1946).—Measurements by means of a concave grating on the near i.r. region are described, together with some interferometric measurements on the rest of the spectrum. Mecke's empirical formula is found not to fit the measurements obtained for the higher members of the series and a quartic equation is obtained which gives a good fit. The molecular constants for the ground state of the iodine molecule are calculated as follows, $\omega_e = 214{\cdot}57$, $B_e'' = 0{\cdot}0375$, $\alpha'' = 0{\cdot}000141\ \text{cm}^{-1}$. A. H.

535.372 = 4 2097

Phosphorescence of nitrogen in the presence of argon. HERMAN, R. *C.R. Acad. Sci., Paris*, **222**, 177–9 (*Jan.* 14, 1946) *In French.*—It is found that when nitrogen, diluted with argon, is caused to phosphoresce, the intensity distribution in the various nitrogen band systems is quite different from that obtained by a discharge through pure nitrogen. Details of the various differences are given and it is pointed out that some of these differences are similar to what would be obtained if the gas were at a high temperature. Possible mechanisms are discussed. A. H.

535.375.5 : 535.343.3–15 = 4 *see Abstr.* 2084

535.375.5 : 539.132 : 535.343–15 = 4 *see Abstr.* 2082

535.39 : 535.8 = 4 *see Abstr.* 2107

535.39 : 614.485 : 535.345.1 *see Abstr.* 2086

535.42 : 535.317.6 = 4 *see Abstr.* 2072

535.423 : 531.717.86 *see Abstr.* 2046

535.43 : 548–15 = 4 2098

On the scattering of polarized light by liquid crystals. CHATELAIN, P. *C.R. Acad. Sci., Paris*, **222**, 229–33 (*Jan.* 21, 1946) *In French.*—Azoxyanisol at 125°C behaves like a uniaxial crystal with $n_e = 1{\cdot}84$, $n_0 = 1{\cdot}56$. The intensity of scattering for the ordinary and extraordinary rays was studied as a function of the angle of scattering ϕ for four cases: optic axis $\parallel$ and $\perp$ to the plane of scattering, and electric vector of the incident ray $\parallel$ and $\perp$ to the plane of scattering. In each case the direction of the incident ray was $\perp$ to the optic axis. The more intense scattered ray has its electric vector $\perp$ to that of the incident ray. The intensity of scattering falls off approximately as $\sin^{-2}\phi$. Para-azoxyphenetol behaves similarly. A. J. C. W.

535.434 2099

Scattering of polarized light by a colloidal graphite solution. DOWLING, J. J. *Nature, Lond.*, **157**, 734–5 (*June* 1, 1946).—Rayleigh's classical experiment with colloidal S is not confirmed, i.e. some light is visible at right angles to the incident light in the plane of the electric vector, as well as perpendicular to it. Investigation of the state of polarization of the scattered light indicates that it is reflected from the faces of minute graphite crystals, rather than scattered.

535.435 = 3 2100

Calculation of form and size of molecular swarms in liquids from light-scattering data. NEUGEBAUER, T. *Z. Phys.*, **122**, 471–86 (1944) *In German.*—The light scattered by molecular swarms in liquids, when the size of the swarm is not negligible compared with the λ of light, is calculated for the two cases in which the electric vector of the primary light is vertical and horizontal, that of the scattered light being horizontal. From the ratio of these intensities the size and form of the swarms can be obtained. Numerical values can be obtained from data due to Krishnan. B. A.

535.435 : 541.65 = 3 2101

Calculation of the scattering of light from filiform chains. NEUGEBAUER, T. *Ann. Phys., Lpz.*, **42** (*Nos.* 7–8) 509–33 (1943) *In German.*—The investigation of molecular structure by measuring the depolarization of the scattered light is inapplicable to filiform chains, extreme anisodiametral particles one or only a few atomic diameters in thickness, owing to the almost insensible change in their anisotropy with increasing number of the chain links. The course of the polarization or depolarization can, however, be followed from

the intensity changes of the scattered light. The necessary formulae are developed. A method is given for determining whether the chains are straight, warped or coiled, and of separating the density and orientation scattering of the solvent from the scattering of the chains. Formulae are also established for chains no longer small in relation to the wavelength of light, from which the straightness of the chains can be decided. H. G. S.

535.56 : 535.81 = 4 *see Abstr.* 2108

535.565–31 = 4 2102

Optical properties of nickel sulphate hexahydrate crystals in the near ultra-violet. MATHIEU, J. P., AND VULDY, G. *C.R. Acad. Sci., Paris*, **222**, 223–4 (*Jan.* 21, 1946) *In French.*—Details are given of measurements on the rotation of the plane of polarization and circular dichroism. It is shown that the maximum of the curve for the latter coincides with the maximum absorption. A. H.

535.64 2103

On the metric of color space. WUNDHEILER, A. W. *J. Opt. Soc. Amer.*, **36**, 288–91 (*May*, 1946).—The available experimental material on colour discrimination is not sufficient to define a metric in the colour space and does not even justify the assumption that this metric is Riemannian. This paper examines what inferences about the geometry of colour space can be made from the known experimental data. They are arranged in the order of their plausibility under the following headings: statements of experimental facts; hypotheses; statements about the geometry of colour space; properties of the discrimination surface.

535.642.1 : 535.73.1 2104

Luminosity curve of trichromats. DE VRIES, H. *Nature, Lond.*, **157**, 736–7 (*June* 1, 1946).—Reports measurements appearing to support Helmholtz's theory of colour vision, in opposition to Granit's theory.

535.65 2105

The evaluation of colorimetric tristimulus values by means of a new centroid method. ROBINSON, H. A. *J. Opt. Soc. Amer.*, **36**, 270–7 (*May*, 1946).—A new semigraphical method of integration which is peculiarly suited to the evaluation of certain integrals which appear with great frequency in colour specification work is introduced and discussed. Previous integration methods either require the use of special equipment or are extremely laborious and time consuming. For essentially linear reflectance curves the tristimulus values can be read from the spectrophotometric curve directly. The accuracy is sufficient for most industrial purposes.

535.7 = 4 2106

Studies on nocturnal vision. LE GRAND, Y. *Rev. Opt. (Théor. Instrum.)* **21**, 71–87 (1942) *In French.*—A survey article which discusses various special features of nocturnal vision—displacement of the visibility curve, accentuation of spherical aberration because of large opening of pupil, etc. Some of the effects obtained and their practical consequences are discussed. The photometric side of the problem is considered and the special difficulties encountered are noted. A. H.

535.73.1 : 535.642.1 *see Abstr.* 2104

535.8 : 535.39 = 4 2107

Photometric study of some optical instruments. Influence of treatment reducing the reflection factor of the surfaces. ARNULF, A., AND FRANÇON, M. *Comm. Lab. Inst. Opt. Paris*, 18–20 (*July*, 1944) *In French.*—Gives experimental results obtained on binoculars and photographic objectives by means of the apparatus described by Arnulf [Abstr. 1557 (1946)]. The importance of correct surface treatment in good quality optical instruments is considerable. N. C.

535.81 : 535.341 = 4 *see Abstr.* 2080

535.81 : 535.36 = 4 2108

Diffusion diagram of an optical instrument. FRANÇON, M. *Comm. Lab. Inst. Opt. Paris*, 21–22 (*July*, 1944) *In French.*—From the variation of stray light factor with angle, the polar curve of diffusion of the frosted surfaces of binocular prisms has been deduced. N. C.

535.824.2 : 535.317.6 *see Abstr.* 2073

535.87 2109

Screen-line tests of paraboloidal reflectors. HAMSHER, D. H. *J. Opt. Soc. Amer.*, **36**, 291–5 (*May*, 1946).—A description of the screen-line test for paraboloidal reflectors is given and the primary considerations involved in its use are presented. The test is useful for reflectors having a face diameter $\geqslant 4f$. A formula for use in determining small errors in surface regularity is included.

535.87 : 771.35 : 535.313 = 4 *see Abstr.* 2071

535.87/88 = 4 2110

Theoretical characteristics of a projector with a parabolic mirror and axial cylindrical source. FÉVROT, C. *Rev. Opt. (Théor. Instrum.)* **23**, 261–76 (*Oct.–Dec.*, 1944) *In French.*—The case is considered of a perfect mirror with a cylindrical source of small dimensions compared to the mirror, the diameter being such that the radiation from the ends may be ignored. The determination of the flux is performed graphically and the results given in tabular form. Several cases are considered, most attention being paid to the variation produced by changing the length of the cylinder and the aperture of the mirror. A. H.

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536.21 : 517.6 *see Abstr.* 2012

536.21 : 621.318.42 2111

Heat conduction in elliptical cylinder and an analogous electromagnetic problem. MCLACHLAN, N. W. *Phil. Mag.*, **36**, 600–9 (*Sept.*, 1945).—The temperature, θ, at the surface of the cylinder is assumed constant, and $\theta = 0$ for $t < 0$ throughout the cylinder, t being the time. The problem solved is that of calculating the temperature at any internal point when $t > 0$. The equation for heat transmission, expressed in elliptical co-ordinates, is solved by means of Mathieu functions. The electrical problem solved relates to a long uniformly wound solenoid having a uniform homogeneous metal core of elliptical cross-section. The magnetizing force at any point in a cross-section of the core is found and this is used to deduce a formula for the variable inductance of the solenoid due to the core flux alone. L. S. G.

536.24.01 : 532.526 *see Abstr.* 2052

536.33.08 : 615.831.7.08 *see Abstr.* 2205

536.46 2112

The combustion of wood. I. BAMFORD, C. H., CRANK, J., AND MALAN, D. H. *Proc. Camb. Phil. Soc.*, **42**, 166–82 (*June*, 1946).—The temperature distribution in heated wood may be calculated by means of the well-known conduction equation provided the temperature is nowhere sufficiently high to cause thermal decomposition. But in the latter case the problem is more complicated because the decomposition is exothermic. The theoretical part of the paper solves such a problem in the case of sheets of wood heated in a simple manner. The experimental part describes the behaviour of wood heated by direct contact with a flame or by radiation. Necessary conditions are found that wood burn with a flame. L. S. G.

536.71 : 541.183.02 *see Abstr.* 2177

536.71 = 3 2113

On the behaviour of the specific volume of gases and liquids. HAVLIČEK, F. J. *Z. Phys.*, **119** (*Nos.* 11–12) 677–84 (1942) *In German.*—On the postulate of the formation of molecular associations in the gas, the investigation shows that the differences of the entropy and internal energy between real and ideal gases are a function of the specific volumes. H. G. S.

ELECTRICITY . MAGNETISM . X-RAYS CHARGED PARTICLES 537/538

537.11 = 4 2114

Derivation of the Liénard–Wiechert's formulae from the retarded potentials. DURAND, E. *C.R. Acad. Sci., Paris*, **222**, 284–6 (*Jan.* 28, 1946) *In French.*—A derivation of the Liénard–Wiechert's formulae for the scalar and vector potentials due to a moving charge utilizing Jacobi's theorem on changes of variables for definite integrals (cf. J. H. Jeans, "Electricity and Magnetism," 5th ed., § 647, 1925). V. C. A. F.

537.12 : 530.145.6 = 4 *see Abstr.* 2038

537.221 : 551.594.25 : 629.135 : 621.396.821 2115

Army-Navy precipitation-static project. III. Electrification of aircraft flying in precipitation areas. STIMMEL, R. G., ROGERS, E. H., WATERFALL, F. E., AND GUNN, R. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 167–77P (*April*, 1946).—[Abstr. 1935 B (1946)].

537.226 : 621.3.011.5 : 621.3.011.2 : 621.315.615 = 4 2116

Conductivity of liquid dielectrics. JOUAUST, R. *Bull. Soc. Franç. Élect.*, **2**, 71–82 (*Feb.*, 1942) *In French.*—[Abstr. 1783 B (1946)].

537.226.1 2117

Dielectric properties of dipolar solids. FRÖHLICH, H. *Proc. Roy. Soc. A*, **185**, 399–414 (*April* 5, 1946).—A quantitative theory is given of the dielectric properties of simple crystalline solids consisting of long-chain molecules. The dipoles (one per molecule) are concentrated in dipolar planes, which, in the ground state, have a permanent polarization, although the polarizations of successive planes usually have opposite directions. The static permittivity rises with increasing temperature up to a critical temperature T_0 and then decreases. The results of a previous paper [Abstr. 2043 (1944)] are extended and a new method is given for treating the dipolar interaction. At T_0 the substance has a phase transition of the second kind. Comparison with experiments on a solid ketone [Abstr. 2575 (1938)] lead to good agreement. For chains with an even number of C atoms metastable states with a permanent polarization are predicted, and a method for reaching these states is discussed. The interaction between dipoles plays a large part at temperatures below T_0. The methods of Lorentz or Onsager [Abstr. 4842 (1936)] are not applicable in the range. L. S. G.

537.226.1 = 4 2118

On the permittivity of metals. CABRERA, N. *C.R. Acad. Sci., Paris*, **222**, 134–6 (*Jan.* 7, 1946) *In French.*—The permittivity of a metal carrying a current is in some sense $4\pi m\sigma^2/Ne^2$, where m and e are the electronic mass and charge, σ is the conductivity, and N the number of free electrons per unit volume. For a metal plate with a field acting normally to the surface it is $\exp(qx)$, where x is measured inwards from the surface and $q^2 = (16\pi^2me^2/h^2)(3N_0/\pi)^{\frac{1}{3}}$; h is Planck's constant and N_0 is the number of free electrons per unit volume in the absence of the field. A. J. C. W.

537.226.2 2119

Barium titanate: a new ferro-electric. WUL, B. *Nature, Lond.*, **157**, 808 (*June* 15, 1946).—[See Abstr. 3009 (1945)].

537.226.8 2120

On the change in the dielectric constants of liquids flowing through narrow separations. SINGH, B. N., AND SINGH, B. D. *Phil. Mag.*, **36**, 622–9 (*Sept.*, 1945).—The experimental arrangements for studying the change (a decrease) are described and results are reported for xylene, CCl_4, toluene, benzene and olive oil. The liquids were made to flow through a specially designed capacitor the variations in whose capacity were obtained by the heterodyne beat method. Wavelengths of the order of 300 metres were used. It seems probable that the changes are caused by the production of electric charges near the interface of the liquids and the plates of the capacitor. L. S. G.

537.228.1 : 534.133 = 3 *see Abstr.* 2063

537.311.37.029.5/.6 : 537.562 : 538.566.2 : 621.396.11 2121

Conduction and dispersion of ionized gases at high frequencies. MARGENAU, H. *Phys. Rev.*, **69**, 508–13 (*May* 1 *and* 15, 1946).—The distribution in energy of electrons in a h.f. electromagnetic field is derived by kinetic theory methods. By use of the distribution law, the current density and hence the (complex) conductivity are calculated as functions of electron density, pressure and frequency of the field. The real part of the conductivity has a maximum for gas pressures, or frequencies, such that the mean free time of an electron is approximately equal to the period of the field. From the conductivity, the permittivity of the medium, its index of refraction, and its extinction coefficient are deduced. The results are applicable in microwave researches and in ionosphere problems.

537.521 : 535.33.08 *see Abstr.* 2074

537.525 = 4 2122

Statistical phenomenon of discharges between electrodes in a vacuum. BERTEIN, F. *C.R. Acad. Sci., Paris*, **222**, 63–5 (*Jan.* 2, 1946) *In French.*—Two parallel stainless steel electrodes, 2 mm apart, were subjected to a p.d. of 60 kV in a vacuum. An apparently static discharge took place. A cathode-ray oscillograph included in the circuit indicated that the space between the electrodes was the seat of very weak discharges with a statistical distribution in time. This can be explained by supposing that the residual currents between the electrodes slowly alter the relief of the cathode surface. Every time a roughness becomes sufficiently marked it becomes the source of a discharge which tends to level it. The effect of varying the applied p.d. is considered. It may be supposed that there is a certain critical surface structure for a given p.d. at which the effect is observed. A. J. M.

537.531 : 535.3 : 548.73 = 3 2123

Reflection of X-rays at crystals. WUNDERLICH, W. *Z. Phys.*, **122**, 86–97 (1944) *In German.*—The regular surfaces obtained by reflection of a monochromatic beam of X-rays at the plane surface of a single crystal are investigated, and their most important plane sections, which can be regarded as diagram curves, are discussed. B. A.

537.531 : 621.386.82 : 615.849.5 *see Abstr.* 2209

537.533.1 : 621.385.2 2124

Electron transit time in time-varying fields. BRONWELL, A. B. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 151 (*March*, 1946).—[Abstr. 2613 B (1945)].

537.533.72 2125

Optical characteristics of a two-cylinder electrostatic lens. GODDARD, L. S. *Proc. Camb. Phil. Soc.*, **42**, 106–26 (*June*, 1946).—Formulae are derived for the 1st and 2nd focal lengths and the positions of the 1st and 2nd principal planes. These involve the voltage ratio of the two cylinders and the separation between the cylinders. The formulae result from the paraxial equation of motion using a development due to Picht. Numerical values of the optical constants are given and the agreement with experiment is good. L. S. G.

537.533.72 2126

A note on the Petzval field curvature in electron-optical systems. GODDARD, L. S. *Proc. Camb. Phil. Soc.*, **42**, 127–31 (*June*, 1946).—Formulae for the curvature, due to Glaser [Abstr. 5220 (1935)] are used to calculate the curvature in the case of a magnetic lens and a 2-cylinder electrostatic lens, with or without separation between the cylinders. Exact results are obtained and the method replaces the approximate one used earlier by Klemperer and Wright [Abstr. 1809 (1939)]. L. S. G.

537.533.74 2127

The scattering of fast electrons by atoms. KAR, K. C. *Indian J. Phys.*, **28**, 147–52 (*Aug.*, 1945).—The wave statistical theory is developed by taking into account the effect of relativity and spin-orbit interaction. The latter is derived from entirely statistical consideration and is in exact agreement with Mott's second correction obtained from Dirac's[4] theory. [See Abstr. 3254 (1929)]. However, Mott's first correction which is independent of the atomic number is not derived by the present method. It is suggested that this correction is due to the spin-spin interaction between the incident electron and the nucleus.

537.533.74 2128

Experiments on the elastic single scattering of electrons by nuclei. VAN DE GRAAFF, R. J., BUECHNER, W. W., AND FESHBACH, H. *Phys. Rev.*, **69**, 452–9 (*May* 1 *and* 15, 1946).—The use of an accurately focused homogeneous beam of electrons from an electrostatic generator made possible clear-cut control of the basic experimental variables, and the experimental method was designed to minimize the effect of X-ray background, etc. Observations were made from 1·27–2·27 eMV at angles from 20°–50° on both sides of the incident beam with Al, Cu, Ag, Pt and Au scattering foils, the atomic numbers thus varying from 13–79. The present results are in close agreement with the relativistic theory of electron scattering, as developed by Mott, over the entire range of the experimental variables except for the case of 2·27 eMV electrons on Al. Excepting this case, the average of all the ratios of experimental result to theoretical prediction is 1·01 with a standard deviation of 0·06. The results of this paper, combined with spectroscopic data, extend the range of validity of the Coulomb law of attraction between electron and nucleus close to the surface of the nucleus.

537.534.79 2129

Capture of electrons by positive ions while passing through gases. SAHA, M. N., AND BASU, D. *Indian J. Phys.*, **28**, 121–35 (*Aug.*, 1945).—This work extends that of Brinkman and Kramers [Abstr. 1301 (1931)]. It is shown that contrary to their opinion, the probability of capture of an electron by the α-particle in the $2p$-orbit from the H-atom becomes much larger than that for the capture in the $1s$-orbit when the velocity falls below $2(2\pi e^2)/h$. For small velocities, the ratio goes on increasing.

537.542 : 550.835 2130

Construction of self-quenching G–M tubes. MCLELLAN, A. G. *N.Z. J. Sci. Tech.*, **27**, 263–5 (*Nov.*, 1945).—A description is given of a Geiger–Müller counter tube, suitable for use in prospecting for radio-active minerals.

537.542.2 = 3 2131

After-effect with counter-tubes. LAUTERJUNG, K. H., AND NEUERT, H. *Z. Phys.*, **122**, 266–8 (1944) *In German.*—After intensive irradiation of a counter-tube with ultra-violet light or γ-rays, the "background" is considerably increased. The normal background is restored after a few minutes. The effect depends largely on the nature of the cathode material, being greatest for substances with a high photo-electric sensitivity, e.g. Mg. B. A.

537.542.2 : 539.166.08 = 3 *see Abstr.* 2149

537.562 : 523.877 : 533.75 *see Abstr.* 2062

537.562 : 538.566.2 : 621.396.11 : 537.311.37.029.5/.6 *see Abstr.* 2121

537.564 = 3 2132

Investigation of the electron avalanche with the cloud chamber. RIEMANN, W. *Z. Phys.*, **122**, 216–29 (1944) *In German.*—The velocity and width of the electron avalanche (cumulative collision-ionization

process) in O_2, CO_2, N_2, air, H_2 and A has been investigated with improved apparatus. The addition of H_2O vapour or EtOH vapour has no effect on the velocity, but has a small effect on the number of carriers, which differs according to the gas. Values of the disordered energy of the electrons, calculated from both the velocity and dimensions of the avalanche, are 1–5 and 0·5–1 V, respectively. B. A.

537.591.1 2133

Cloud-chamber photographs of heavy particles at high altitudes. HUGHES, D. J. *Phys. Rev.*, **69**, 371–81 (*May* 1 *and* 15, 1946).—The determination of mass of heavily ionizing particles and knock-on electrons from cloud-chamber photographs is discussed in general and the methods are applied to specific tracks of a series of 5 000 photographs obtained at an altitude of 15 500 ft. It is shown that the errors of mass determination are large but that there is good evidence for a distribution of mesotron masses. The number of slow mesotrons at 15 500 ft $\simeq$ the slow protons = 1% of the fast mesotrons at that altitude. The extremely rapid increase of slow mesotrons with altitude probably means that they are created as such at high altitudes. One photograph, which shows the pair production of low energy mesotrons, is an example of such a process.

537.591.1 2134

Analysis of cosmic-ray fine structure. II. Mexico City observations. WARREN, D. T. *Phys. Rev.*, **69**, 382–4 (*May* 1 *and* 15, 1946).—The method previously developed [Abstr. 1659 (1946)] has been applied to the preliminary data of Schremp and Baños. The nature of the anomalies is quite different from that in Missouri. The irregularity near the zenith has already been discussed, and it is shown that the 36° one cannot be interpreted as due to absorption. The irregularities in the slopes of the curves are extremely puzzling.

537.591.1 2135

A cloud-chamber analysis of cosmic rays at 14 120 ft. POWELL, W. M. *Phys. Rev.*, **69**, 385–405 (*May* 1 *and* 15, 1946).—Protons and mesotrons near the end of their ranges are distinguished from each other by a method involving the degree of ionization in the gas of the cloud chamber and the scattering in the Pb plates in the chamber. Photographs are shown of the production of protons and mesotrons in the Pb by non-ionizing and ionizing radiation. Evidence is presented for the presence of an extremely large number of neutrons. Both neutrons and protons are shown to be secondary particles with a maximum energy near 200 eMV. The conclusion is reached that this maximum energy arises from the large cross-section of the atmosphere for the production of pairs of mesotrons. The value of this maximum energy can be used as a measure of the mass of the mesotron. Photographs are shown of cascade showers produced by knock-on electrons, stars produced in the Pb and the gas of the chamber, and Auger showers filling the whole chamber.

538.114 : 538.245 2136

Collective electron assemblies in a metal with overlapping energy bands. I. General theory; II. The occurrence of ferromagnetism. BAND, W. *Proc. Camb. Phil. Soc.*, **42**, 139–55 (*June*, 1946).—Assemblies are considered when holes in a nearly full *d*-band are in equilibrium with free electrons in an overlapping *s*-band. It is shown that in a metal with such overlapping energy bands, one of which is nearly full, the other nearly empty, there exists a critical temperature, T_c, below which spontaneous magnetization will be present. An approximate expression for T_c is given. Application is made to the determination of the form of the *d*-bands in Ni, Co, Fe and the alloys Cu–Ni, Ni–Co, Fe–Co, Fe–Ni, Cu–Fe and the Mn and Heusler alloys. The forms of the *d*-bands given permit the construction of band-head forms for all compositions of the major ferromagnetic alloys by addition of the component curves with proper weighting factors. L. S. G.

538.122 : 621.318.423 : 621.3.013.2 2137

The electromagnetic field of a solenoid. BOTTEMA, O. *Physica, 's Grav.*, **8**, 703–10 (*July*, 1941).—[Abstr. 1745 B (1946)].

538.221.029.6 2138

Magnetic permeability of nickel in the region of centimetre waves. SIMON, I. *Nature, Lond.*, **157**, 735 (*June* 1, 1946).

538.245 : 538.114 *see Abstr.* 2136

538.27 : 539.4.016.2 2139

Magnetic self-recovery in cold-worked copper. REEKIE, J., AND HUTCHISON, T. S. *Nature, Lond.*, **157**, 807–8 (*June* 15, 1946).—Cold working of pure Cu rods reduces the diamagnetic susceptibility, which then recovers at a rate dependent on the temperature. The indication is that magnetic susceptibility is strain-sensitive, as cold-worked Cu is known to exhibit self-recovery from strain [see Abstr. 1396 (1946)].

538.54 = 4 2140

Dissipation of energy due to eddy currents induced in a ferromagnetic circular disc by a varying magnetic field normal to its plane. RIBAUD, G. *C.R. Acad. Sci., Paris*, **222**, 726–7 (*March* 25, 1946) *In French.*—The loss of energy, W', is compared with the corresponding loss of energy, W, for the case of a non-magnetic circular disc, obtained in an earlier paper [*ibid.*, **216**, 377 (1943)]. It appears that W'/W tends towards zero as the magnetic permeability of the disc becomes infinitely large. V. C. A. F.

538.566.2 : 621.396.11 : 537.562 : 537.311.37.029.5/.6 *see Abstr.* 2121

538.61 : 535.36 = 4 *see Abstr.* 2089

RADIOACTIVITY . ATOMS . MOLECULES 539

539.13 : 535.343–15 = 4 *see Abstr.* 2083

539.132 : 535.375.5 : 535.343–15 = 4 *see Abstr.* 2082

539.133 : 541.57 2141

Resonance energy of the tetrachlorethylene molecule. DUCHESNE, J. *Nature, Lond.*, **157**, 733 (*June* 1, 1946).

539.133 = 4 2142

Left torsion frequency of the ethylene molecule. DUCHESNE, J. *Physica, 's Grav.*, **10**, 817–22 (*Dec.*, 1943) *In French.*—The magnitude of an exchange integral between ethylene electrons is evaluated as 34 kcal/mole. From this result, and the statistical interpretation of specific heats, a choice can be made of the two suggested assignments for the fundamental frequencies of the molecule, and the left torsion

frequency can be placed at $\sim 950\ cm^{-1}$. Independent support is adduced to a discussion of the value of the heat of sublimation of carbon. N. M. B.

539.152.1 : 539.17 *see Abstr.* 2154

539.153 = 3 2143

Distortion factor in the extended statistical theory of the atom and its application to the calculation of polarizability. GOMBÁS, P. *Z. Phys.*, **122,** 497–509 (1944) *In German.*—Expressions are deduced for the density change in the electron cloud and the distortion energy, which show some similarity to the wave-mechanics expressions. The results are applied to the calculation of the polarizability of inert-gas atoms, and ions with an inert-gas configuration. There is satisfactory agreement with experiment in the case of heavy atoms and ions, but there are larger deviations for light atoms and ions in consequence of the statistical nature of the calculation. The theoretical values are always > the experimental. B. A.

539.154.2 = 3 2144

Plane arrangement of the periodic system according to quantum numbers. FINKE, W. *Z. Phys.*, **122,** 230–2 (1944) *In German.*—Two plane arrangements of the periodic system are given which bring out the quantum-number relationships. The second, in which atomic number is plotted against principal quantum number, is useful in connection with term schemes. B. A.

539.155.2 2145

Partial separation of the isotopes of chlorine by thermal diffusion. SHRADER, E. F. *Phys. Rev.*, **69,** 439–42 (*May* 1 *and* 15, 1946).—The Clusius–Dickel isotope separator has been modified by employing two coaxial Pyrex glass cylinders to allow larger scale separation of the isotopes of Cl. The modified special design was necessary to allow for the heating and the resulting thermal expansion of the inner cylinder. The operation compares favourably with that predicted by the theory of Furry, *et al.* [Abstr. 2666 (1939)]. The degree of isotope separation was determined directly by mass-spectrographic and spectrographic analyses. The concentration of Cl^{37} was also determined by measuring the amount of induced radioactivity resulting from deuteron bombardment of the sample to be analysed. Sufficient chlorine gas containing 45% Cl^{37} was obtained for the determination by spectrographic means of the nuclear spin of Cl^{37}.

539.155.2 = 3 2146

Photometric determination of rare isotopes. Relative isotope abundances and atomic weight of nickel. EWALD, H. *Z. Phys.*, **122,** 686–96 (1944) *In German.*—The relative abundances of isotopes of a given element are obtained from mass spectrograms by photometric comparison with spectrograms obtained with a reference element of known isotopic composition. With a constant rate of ion emission from both sources, isotopes of widely differing abundances can be made to give lines of comparable intensity by varying the exposure, and the proportion of the rarer isotopes can be estimated from the line intensity and exposure. Ni has isotopes of mass-number 58, 60, 61, 62 and 64 (abundances 69·18, 25·82, 0·97, 3·28 and 0·75%, respectively), the derived atomic weight being $58{\cdot}66_2 \pm 0{\cdot}02_5$. B. A.

539.155.2 : 533.15 2147

Isotope separation by thermal diffusion: The cylindrical case. FURRY, W. H., AND JONES, R. C. *Phys. Rev.*, **69,** 459–71 (*May* 1 *and* 15, 1946).—The theoretical treatment of the plane case previously given [Abstr. 2666 (1939)] is here extended to include the cylindrical case. The extension is carried through in general, that is, for a gas whose physical properties are arbitrary functions of the temperature. The difficulty of the calculations is enormously increased by the explicit appearance in the characteristic differential equation of the radius as a function of the temperature. The solution is here carried through in detail only for a perfect gas whose viscosity, thermal conductivity and diffusivity have the same temperature dependences as those of a Maxwellian gas. Exact numerical solutions for a few cases have been obtained, but it was found desirable to develop approximate methods of solution. Two different kinds of approximate solutions are given: a series solution useful when the ratio of radii is not larger than about 4 or 5, and an asymptotic solution valid when the ratio of radii is large, as in the case of the hot-wire types of separation column.

539.163.4 : 539.172.4 *see Abstr.* 2156

539.164.08 : 550.835 2148

An alpha-ray ionization chamber for radioactivity measurements. MCKELLAR, I. C. *N.Z. J. Sci. Tech.*, **27,** 259–62 (*Nov.*, 1945).—A semi-portable ionization chamber is described suitable for rapid measurements of total α-ray emission from the surface of sand or powdered rock samples.

539.166.08 : 537.542.2 = 3 2149

Sensitivity of counter-tubes with lead, brass and aluminium cathodes for γ-rays in the energy range 0·1 to 3 eMV. BRADT, H., GUGELOT, P. C., HUBER, O., MEDICUS, H., PREISWERK, P., AND SCHERRER, P. *Helv. Phys. Acta*, **19** (*No.*2) 77–90 (1946) *In German.*—The relative sensitivities were determined as a function of the applied quantum energy, by comparison of the collision numbers for γ-rays of known energy. Satisfactory agreement was obtained with the relative sensitivity calculated from the formula of von Droste. The absolute sensitivity has also been determined for a series of quantum energies as follows: (1) for the 0·51 eMV annihilation radiation of positrons of RaC″; (2) the 0·75 eMV γ-radiation from UZ; (3) γ-radiation of energy 173 ekV and 247 ekV from 65 hr In; (4) the 2·62 eMV component of γ-rays from ThC″; (5) the 0·242 eMV γ-radiation from ThB. A. J. M.

539.167.3 2150

Separation of nuclear isomers in the electric field. CAPRON, P. C., STOKKINK, G., AND VAN MEERSSCHE, M. *Nature, Lond.*, **157,** 806 (*June* 15, 1946).—The isomeric filiation of Br^{80} has been proved by a physical method, collecting the isomers when partly separated by means of an electric field using electrodes in a non-electrolytic solution. The anode, 3 hours after irradiation, showed strong 17·4 min activity in addition to the 4·4 hr. Without the field there was no 17·4 min activity [see Abstr. 1348 (1942)].

539.167.3 = 3 2151

Coincidence measurements with radioactive sodium isotopes. MAIER-LEIBNITZ, H. *Z. Phys.*, **122,** 233–47

(1944) *In German.*—Arrangements of counter tubes were used to investigate β–γ and γ–γ coincidences for radiation from Na^{22} and Na^{24}. For both these isotopes all β-rays are coupled with γ-rays, and the β-spectra are simple. For Na^{22} the number of β-rays is the same as the number of γ-rays. The energy change in the transformation $Na^{22} \rightarrow Ne^{22}$ is 1·9 eMV. This gives a mass of 22·00172 for Na^{22}, calculated from the mass of Ne^{22}. *K*-capture by Na^{22} is not markedly coupled with γ-radiation. At least three excitation states of Mg^{24} occur in the production of this nucleus from Na^{24}. In each decomposition at least two γ-quanta are emitted simultaneously. The energy change in the case of Na^{24} is at least 5·4 eMV. B. A.

539.17 2152

On the variation along range of the $H\rho$-distribution and the charge of the fission fragments of the light group. Lassen, N. O. *Phys. Rev.*, **69**, 137–9 (*March* 1 *and* 15, 1946).—Using apparatus previously described [Abstr. 553 (1946)], the $H\rho$-distribution for fission fragments of the light group from U after having traversed mica foils of various thicknesses has been determined. The most probable energy of the light group is plotted against the thickness of the mica foil traversed. The Bohr relation, $Z_{eff} = Z^{\frac{1}{3}}(V/V_H)$ for the effective charge Z_{eff}, where Z is the atomic number, V_H is the electron velocity in the hydrogen atom and V is the velocity of the fragments, cannot account satisfactorily for the experimental data, probably because of the relatively high value of the ratio Z_{eff}/Z. A. J. M.

539.17 2153

The possibility of initating thermo-nuclear reactions under terrestrial conditions. Poole J. H. J. *Sci. Proc. R. Dublin Soc.*, **24**, 71–6 (*May*, 1946).—The problem of initiating thermo-nuclear reactions of a stellar scale on the earth are discussed, using the available experimental and theoretical data. Firstly it is shown that the energy generated, if all the hydrogen of sea water were converted to helium, would raise the temperature of the earth to $2{\cdot}7 \times 10^{6}$°c. Secondly it is shown that the maximum temperature produced in a uranium atomic bomb is $15\,000 \times 10^{6}$°c, so that, if such an explosion is initiated in water, the temperature of the surrounding water will be raised to a very high value, giving rise to several nuclear reactions the most important of which is shown to be ${}_1D^2 + {}_1D^2 \rightarrow {}_2He^3 + {}_0n^1$. The optimum temperature for this reaction is calculated to be 28×10^{6}°c and the minimum radius of a sphere of water in which such a thermo-nuclear reaction could be maintained is shown to be $3{\cdot}1 \times 10^{6}$ km, thus demonstrating the negligible chance of exploding the ocean by dropping an atomic bomb in the sea. W. E. D.

539.17 : 539.152.1 2154

Schematic treatment of nuclear resonances. Breit, G. *Phys. Rev.*, **69**, 472–88 (*May* 1 *and* 15, 1946).—A schematic model of competitive nuclear disintegration processes is examined with special attention to the following features: (*a*) The definition of the compound state in a manner independent of the introduction of a "nuclear radius" into the definition; (*b*) the evaluation of the influence of barrier penetration on the parameters entering the dispersion formulae; (*c*) the comparison of the equivalent disintegration probabilities entering as products in the numerators of the dispersion terms with the resonance widths which occur as coefficients of i in the imaginary part of the denominators in the same formulae. It is found that a definition of the compound state can be given in the case considered without the aid of an arbitrarily assigned nuclear radius. The definition of the compound state is arranged to be such as to be nearly independent of the potential barriers affecting the disintegration products. The damping constants turn out to be expressible primarily through the regular radial functions f and are found to depend also on the irregular functions g, inasmuch as the latter determine the linear combinations with which the different damping integrals denoted by $I_n^{(q)}$ combine to give the damping constants Γ. The cross-sections can be expressed in the present model in terms of determinants with a finite number of rows and columns. The answer is also transformed into a "dispersion formula" form and it is found that the relation between the resonance width and the disintegration probabilities can be made to be exact in the "isolated level" form but is only an approximation in the representation of the general case that has been used.

539.172.1 : 539.185 2155

The yield function and angular distribution of the D + D neutrons. Bennett, W. E., Mandeville, C. E., and Richards, H. T. *Phys. Rev.*, **69**, 418–22 (*May* 1 *and* 15, 1946).—The thin target yield of neutrons from the D + D reaction has been measured for deuteron energies 0·5–1·8 eMV. The neutron yield in the forward direction increases smoothly throughout the interval, but the yield at 80° to the bombarding beam remains almost constant. Values of A in the expression $(1 + A\cos^2\theta)$ representing the angular distribution of the neutrons in the centre of gravity coordinate system are calculated from the yield data and plotted as a function of voltage. A is found to increase from 1·8 at 0·5 eMV deuteron energy to 3·4 at 1·8 eMV.

539.172.4 : 539.163.4 2156

Chemical forms assumed by C^{14} produced by neutron irradiation of nitrogenous substances. Yankwich, P. E., Rollefson, G. K., and Norris, T. H. *J. Chem. Phys.*, **14**, 131–40 (*March*, 1946).—The compounds discovered are listed and an attempt is made to interpret the results in terms of the processes in which the C^{14} atoms must be involved in the dissipation of the recoil energy associated with their formation. The fact that several compounds are produced in radioactive form in the original irradiation eliminates the necessity for the synthesis from radioactive carbon dioxide of these compounds for use in tracer work. A simplified method for the preparation of C^{14} is suggested.

539.185 2157

The scattering of neutrons by magnesium. Little, R. N., Long, R. W., and Mandeville, C. E. *Phys. Rev.*, **69**, 414–17 (*May* 1 *and* 15, 1946).—Energies of 2·5 eMV neutrons from the D + D reaction scattered through Mg were measured in a cloud chamber. The neutron energy spectrum showed that Mg has

its lowest excited level at 1·30 eMV above the ground state. Approximate values of the elastic and inelastic scattering cross-section were calculated as $1{\cdot}6\times10^{-24}$ and $0{\cdot}6\times10^{-24}$ cm², respectively.

539.185 : 539.172.1 *see Abstr.* 2155

539.185.7 2158

The velocity dependence of the absorption of boron for slow neutrons. MANLEY, J. H., HAWORTH, L. J., AND LUEBKE, E. A. *Phys. Rev.*, **69**, 405–11 (*May* 1 *and* 15, 1946).—Measurements of the slow neutron velocity distribution between 1 and 10 km/sec from a 14-cm cube of paraffin, with a source of 2·5 eMV neutrons in the centre, show the distribution to be approximately Maxwellian with $T = 400°K$, but with an excess of fast neutrons for $V > 3{\cdot}5$ km/sec. Similar measurements of the distribution of neutrons transmitted through a boron absorber verify the assumed $1/v$ absorption law in this velocity range.

539.185.7 2159

Capture cross-sections for slow neutrons. COLTMAN, J. W., AND GOLDHABER, M. *Phys. Rev.*, **69**, 411–13 (*May* 1 *and* 15, 1946).—Neutrons from a Ra–α–Be source are slowed down in a paraffin block containing a cylindrical cavity. A BF_3 detector in the centre of the cavity measures the reduction in neutron intensity which results when an element or compound under investigation "suspended" in graphite powder is introduced into the cavity. The arrangement is calibrated with B. The method has been used to measure the capture cross-section of 19 elements. The results are tabulated.

539.185.7 2160

Experiments with a slow neutron velocity spectrometer II. BACHER, R. F., BAKER, C. P., AND MCDANIEL, B. D. *Phys. Rev.*, **69**, 443–51 (*May* 1 *and* 15, 1946).—The apparatus previously used [Abstr. 885 (1941)] for the determination of neutron energy by time of flight method has been completely rebuilt to increase the accuracy of measurement as well as the high energy limit. The repetition frequency is obtained from a series of relaxation oscillators and a 50-kc oscillator and frequencies of 100, 200, 500, 1 000 and 2 500 c/s are available. Four detector channels have been built so that neutrons in four different time of flight groups can be counted simultaneously. When used with the highest repetition frequency, this decreases the time to obtain data by a factor of 24. The study of the transmission of Ag with a 1·35 g/cm² absorber shows a single strong resonance at 5·8 eV. A re-examination of In with considerably higher resolution than was previously used shows a single resonance at about 1·35 eV. The effective mean life of neutrons in several different sources was examined and a thin paraffin source with Cd backing devised for measurements in the thermal region. The absorption of B has been examined and found to be proportional to $1/v$ within the limits of error of the experiment, from 0·028–50 eV. An experiment to determine the B cross-section of the Cd stopped neutrons gave 540×10^{-24} cm². The B absorption curve shows that the cross-section of thermal neutrons (0·025 eV) is 708×10^{-24} cm². It is concluded that the effective energy of the Cd stopped neutrons is not that of kT at thermal energy, for the geometry used, but is 0·041 eV. This conclusion is confirmed by the measured resonances in Ag and In which are higher than the values obtained by the B absorption method. Correction of these values, as measured by Horvath and Salant [Abstr. 671 (1941)] for the effective energy of the Cd stopped neutrons, leads to 1·32 eV for In and 5·2 eV for Ag, in agreement with the present results. It is concluded that resonances measured by the B absorption method are in error by an amount which depends upon the geometry of the experiment, and are probably too low by a factor of $0{\cdot}041/0{\cdot}025 = 1{\cdot}64$.

539.185.7 2161

On the theory of the slowing down of neutrons in heavy substances. PLACZEK, G. *Phys. Rev.*, **69**, 423–38 (*May* 1 *and* 15, 1946).—The rigorous solution of the integral equation for the stationary energy distribution in the case of slowing down without capture is given and its relation to the average energy loss discussed. The problem of mixtures is treated, and it is shown, in particular, that for mixtures of a light and a heavy substance concentrations exist for which the energy distribution is at the beginning entirely determined by the energy loss in the heavy substance and at the end by the energy loss in the light substance. The effects of capture are discussed and it is shown that the solution assumes a simpler form if the ratio of the mean free paths for scattering and capture varies slowly over energy regions of the order of the average energy loss. The case of $1/v$ capture is treated in detail and rapidly varying capture discussed. A simplified treatment, based on the concept of neutron age, is given, and its limitations are discussed; also the effects of the chemical binding on the energy distribution. An expression for the mean square distance of diffusion and its mass dependence is derived.

539.185.7 = 3 2162

Absorption of thermal neutrons in carbon. BOTHE, W., AND JENSEN, P. *Z. Phys.*, **122**, 749–55 (1944) *In German.*—The length of diffusion paths (l) of thermal neutrons in graphite has been measured by introducing a source of fast neutrons into the centre of a graphite sphere surrounded by H_2O, and measuring the concentration of thermal neutrons inside the sphere, with and without a Cd film between the sphere and the H_2O. The value of l found is 40 cm or 67 ± 4 g/cm², giving a mean absorption cross-section for pure C of $6{\cdot}4 \pm 1\times10^{-27}$ cm², after making a correction for absorption by the ash content. B. A.

539.185.7 = 3 2163

Retardation of neutrons in carbon, water and heavy water. JENSEN, P. *Z. Phys.*, **122**, 756–68 (1944) *In German.*—The mean ranges of neutrons from different sources have been measured in C and in D_2O by measurements of neutron concentration with Rh and In detectors along the axis of a prism of the material. Values given by graphite were 101 g/cm² for neutron energy 0·55 eMV, 106 g/cm² for (Ra + Be) neutrons, and 108 g/cm² for 3·7 eMV neutrons. The effective energy for (Ra + Be) neutrons is calculated as 2·7 eMV. The latter had a range of 45 cm in D_2O. Scattering cross-sections are calculated as : H, $5{\cdot}27\times10^{-24}$; D, $1{\cdot}77\times10^{-24}$; C, $2{\cdot}72\times10^{-24}$; O, $2{\cdot}2\times10^{-24}$ cm² for neutrons of energy 0·9–2·7 eMV. B. A.

39.185.7 = 3 2164

Interaction of neutrons and γ-rays with beryllium. ÜNFER, E., AND BOTHE, W. *Z. Phys.*, **122**, 769–77 1944) *In German.*—The diffusion range of thermal eutrons, and neutron multiplication by (Ra α + Be), Ra α + F) and photo-neutrons (from Ra γ-radiation), ave been studied in Be metal by means of Dy etectors in an Al sphere which could be surrounded y a film of Cd. The neutron source was ~500 mg of a (as $RaSO_4$) + Be. The diffusion range of thermal eutrons is >25 g/cm², and the capture cross-section $<16\times10^{-27}$ cm². With (Ra α + Be) neutrons the ean effective cross-section for the Be^9 (n, 2n) process s <3 times that for the (n, α) process, and approaches he geometrical nuclear cross-section of $0{\cdot}3\times10^{-24}$ m². The mean effective cross-section for the Be^9 (n, α) process and the (Ra α + Be) neutrons above he excitation limit is nearer 10^{-25} than 10^{-24} cm². With the lower-energy (Ra α + F) neutrons the ffective cross-sections are approx. the same for the n, 2n) and (n, α) processes. Photo-neutrons, amounting to ~34% of those produced by the α-radiation rom Ra, were obtained when a Ra preparation was urrounded by 26 kg of Be as foil or 2 kg of fused Be. B. A.

STRUCTURE OF SOLIDS 539.2

539.23 : 535.345.1 = 3 *see Abstr.* 2087

539.23 : 620.191.2 2165

Crack-heal mechanism of the growth of invisible ilms on metals. EVANS, U. R. *Nature, Lond.*, **157**, '32 (*June* 1, 1946).—It appears unnecessary to postulate *ad hoc* mechanisms for the growth of oxide ilms on iron and zinc, as the facts are explained by the eal-crack-heal sequence, for which experimental upport is here presented. The primary effect of air-xposure is to heal existing pores, and the secondary ffect is to introduce new ones; the effects are nterconnected.

539.26 : 621.357.8 = 3 2166

Investigation of electrolytically polished metal surfaces by electron interference. KRANERT, W., LEISE, K. H., AND RAETHER, H. *Z. Phys.*, **122**, 248–61 (1944) *In German.*—Metallic surfaces polished electrolytically have been investigated by electron interference. A single-crystal surface is polished better than a polycrystalline one, whose interference diagram shows points in place of the usual ring; these points are elongated towards angles < the corresponding Bragg angle. The upper ends of the tailed spots lie on the normal powder ring. This effect is due to a refraction of the electron beam on entry into the crystal surface, and is marked on account of the fact that the surface is so nearly plane. Interference patterns show that electrolytic polishing is effected by removal of projections on the surface, in contrast to mechanical polishing, in which the projections are pushed into hollows, and the surface of the crystal is deformed. Electrolytic etching of a Cu surface, previously electrolytically polished, has also been investigated. The roughening of the surface can be followed from the appearance of the spots on the interference diagram, which become rounder as the surface becomes rougher. With HCl as electrolyte, a layer 100 Å thick may be removed without visible change in the tailed spots. At 150–200 Å, some of them have become rounded in the case of a single-crystal surface, and all of them if the surface is polycrystalline. With H_3PO_4 as electrolyte a layer ~1 000 Å thick can be removed before there is any roughening of the surface. B. A.

539.264 = 4 2167

X-ray study of ethylene polysulphides. TERTIAN, R., AND TRILLAT, J. J. *Rev. Sci., Paris*, **83**, 21–6 (*Jan.*, 1945) *In French.*—Long-chain polymers of $-CH_2-CH_2-S-\underset{\underset{S}{\|}}{\overset{\overset{S}{\|}}{S}}-$ ("thiokol") have properties similar to those of rubber, but are less affected by organic solvents. X-ray photographs of pure unstretched thiokol show only two diffuse rings, but on stretching by 50% or more a fibre structure appears, consistent with an orthorhombic unit cell of dimensions $a = 8{\cdot}57$, $b = 5{\cdot}03$, $c = 4{\cdot}27$ kx. The c axis is in the direction of stretch, and the orientation remains on removal of the stress. Commercial thiokol loaded with C and ZnO shows a similar but less pronounced orientation, which disappears on vulcanization. It reappears on stretching vulcanized thiokol by about 200%, but is never as perfect as with the pure unvulcanized substance. A. J. C. W.

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.312 2168

Impedance representation of tangential boundary conditions. CAMP, G. D. *Phys. Rev.*, **69**, 501–2 (*May* 1 *and* 15, 1946).—The importance of tangential boundary surface forces in some systems is noted. The tensor formulation of a generalized impedance boundary condition, involving a tangential as well as a normal impedance, is given. The tangential impedance, seen by a plane working into a viscous fluid, is calculated.

539.312 2169

A variational method for linear dissipative anisotropic elastic systems. CAMP, G. D. *Phys. Rev.*, **69**, 502–7 (*May* 1 *and* 15, 1946).—A boundary value problem, governing a quite general elastic system, is defined. Although limited to steady-state drive (or free vibrations), it is applicable to transient drives by the usual method of Fourier superposition. A variational principle, rigorously equivalent to this boundary value problem, is given. It is amenable to the direct or semi-direct method, and thus takes advantage, in the choice of trial functions, of any qualitative or semi-quantitative knowledge of the system. It furnishes practically useful approximations, with reasonable labour, to the solution of problems which have not been treated successfully by other methods. An example is worked out in detail and the solution is interpreted physically.

539.374 2170

A note on the equations of plane plastic flow. SNEDDON, I. N. *Phil. Mag.*, **36**, 629–35 (*Sept.*, 1945).—A possible approach to 2-dimensional problems of plastic flow by the methods of Stevenson [Abstr. 827 (1944)] is suggested. The method is illustrated by finding the solutions of some well-known problems.

One of these is the so-called "vertical flow" in a plastic mass. L. S. G.

539.4.016.2 : 538.27 *see Abstr.* 2139

539.501 : 541.182.6 2171

Theory of the rheological properties of dispersions. FRÖHLICH, H., AND SACK, R. *Proc. Roy. Soc. A*, **185**, 415–30 (*April* 5, 1946).—A set of differential equations describing the properties of flow of substances showing elastic recovery is derived. These equations contain 3 parameters which, in the case of dispersions, may be calculated from the properties and concentration of the components. The physical model forming the basis of the macroscopic theory which is given is this: the dispersion consists of independent solid micelles embedded in a viscous fluid, and the micelles are considered to be elastic spheres while the fluid is treated according to classical hydrodynamics. L. S. G.

539.6 : 532.7 = 4 *see Abstr.* 2054

539.621 2172

Visible hot spots on sliding surfaces. BOWDEN, F. P., AND STONE, M. A. *Experientia*, **2**, 186–8 (*May* 15, 1946).—Bright spots of light were observed when a glass or quartz plate was rubbed over different metal surfaces even with very weak pressures. The local temperatures must have been at least 550°C. The cumulative effect of these flashes is sufficient to be recorded photographically.

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.121/.128

541.127.1 : 535.371 2173

A note on the theory of diffusion controlled reactions with application to the quenching of fluorescence. MONTROLL, E. W. *J. Chem. Phys.*, **14**, 202–12 (*March*, 1946).—The principles of Smoluchowski's collision theory of reactions in solution are outlined. This theory is applicable to reactions which occur immediately on the collision of two reactant particles; that is, diffusion controlled reactions. The rate of such reactions depends on the collision frequency of reactants. In this paper an expression for the collision frequency is derived as a function of time when initially there is a Boltzmann distribution of particles around any particular reactant molecule. Both the Brownian motion of and the forces between reactant molecules are considered in the calculation. The general results are applied to the theory of quenching of fluorescence. It is shown that the quenching constant, k_Q, defined by $[(I_0/I) - 1]/n_Q$ (where I_0 is the intensity of fluorescence in the absence of quencher and I the intensity in the presence of quencher of concentration n_Q) can be expressed as a sum of two terms, one $\propto$ (viscosity of the solvent)$^{-1}$ and the other $\propto$ (viscosity)$^{-\frac{1}{2}}$.

ELECTROCHEMISTRY 541.13

541.134 : 541.135.5 2174

The mechanism of electrode measurements. BRITTON, H. T. S. *J. Sci. Instrum.*, **23**, 89–94 (*May*, 1946).—The paper commences with a discussion of the potential difference between a solid and a liquid and its measurement, the derivation of standard equations, diffusion potentials and their calculation from Hittorf migration numbers, and liquid junction potentials with Bjerrum's method of estimating them. Sections are then devoted to the hydrogen, quinhydrone, oxygen and air, and glass electrodes. Two important points in connection with *p*H-meters are: (1) The directly indicating *p*H dial is based on the rectilinear relationship between e.m.f. and *p*H, where the slope is $-2{\cdot}303RT/F$ and where an initial adjustment is necessary to allow for the asymmetry potential, E_a. Since the slope is a function of temperature, it is essential to use the *p*H meter at the temperature for which it was designed. (2) The above rectilinear principle is not true above *p*H 8·5, when it will be necessary to correct the instrument for the alkali-metal ion concentrations especially when used to measure high *p*H values. H. H. HO.

541.135.5 : 541.134 *see Abstr.* 2174

541.135.5 = 4 2175

Investigation of current build-up curves across a mercury dropping electrode using a cathode-ray oscillograph. BON, F. *C.R. Acad. Sci., Paris*, **222**, 286–8 (*Jan.* 28, 1946) *In French.*—The dropping electrode which was negatively polarized was connected in series with a known variable resistance to which the c.r.o. was connected. The variation of the current wave form with the following parameters was examined: (1) Pressure head causing dropping. (2) Drop frequency (0·2–40 drops/sec). (3) Series resistance. (4) Solution concentration. (5) Nature of solution. An explanation is offered for the peculiarities of the curves obtained.

PHOTOCHEMISTRY 541.14

COLLOIDS . ADSORPTION 541.18

541.18 : 621.355.1 = 4 2176

Colloids and the manufacture of electric accumulators. TARRIN, M. *Bull. Soc. Franç. Élect.*, **2**, 227–32 (*May*, 1942) *In French.*

541.182.6 : 539.501 *see Abstr.* 2171

541.183.02 : 532.64 *see Abstr.* 2053

541.183.02 : 536.71 2177

Surfaces of solids. XV. First-order phase changes of adsorbed films on the surfaces of solids: the film of *n*-heptane on ferric oxide. JURA, G., LOESER, E. H., BASFORD P. R. AND HARKINS, W. D. *J. Chem. Phys.*, **14**, 117–23 (*March*, 1946).—Two-dimensional first-order changes, in which a gaseous film of normal heptane is transformed into another phase of lower molecular area with evolution of heat, have been discovered on subphases of ferric oxide, silver and graphite. All of the critical phenomena observed in 3-dimensional systems are found to be duplicated. For *n*-heptane on ferric oxide the critical constants

are: σ_c (area) 900 Å² per molecule; π (film pressure) 0·45 dyne cm^{-1}; and T_c, 29°C. The critical constants are found to depend on the nature of the solid as well as on that of the vapour. The heat of transformation at 25°C is estimated to be 12 000 ± 5 000 cal/mole. This value appears to be considerably higher than the 6 150 cal/mole required for the formation of 3-dimensional liquid *n*-heptane from its vapour at the same temperature. The volume-pressure relations are considered for the adsorption isotherm in the case in which a 2nd- or 3rd-order phase change occurs.

CHEMICAL STRUCTURE 541.2/.6

541.57 : 539.133 *see Abstr.* 2141

541.634 2178

Structure of the so-called *cis*-decalin. BASTIANSEN, O., AND HASSEL, O. *Nature, Lond.*, **157**, 765 (*June* 8, 1946).

541.634 2179

Two forms of 1,3 butadiene. WALSH, A. D. *Nature, Lond.*, **157**, 768 (*June* 8, 1946).—[See Abstr. 101 (1946)].

541.64 : 532.72 *see Abstr.* 2057

541.65 : 535.435 = 3 *see Abstr.* 2101

CHEMICAL PROCESSES . APPARATUS 542

542.7 2180

An automatic burette for the delivery of gas at constant pressure. HODGINS, J. W., AND HARVEY, R. B. *Canad. J. Res. B*, **24**, 81–2 (*May*, 1946).—The apparatus controls automatically the addition of gas from a gas burette to a system maintained at constant pressure. A phototube-relay, actuated by the mercury level of a manometer connected to the system, acts as the control mechanism for the gas input.

CHEMICAL ANALYSIS 543/545

545.82 2181

Spectrochemical analysis with the oscillograph. DIEKE, G. H., AND CROSSWHITE, H. M. *J. Opt. Soc. Amer.*, **36**, 192–5 (*April*, 1946).—The method is based on work described in Abstr. 2074 (1946). A separate photo-tube is used for each line under examination and these tubes are connected to the oscillograph by means of a rotating switch. A trace is obtained for each line under examination and relative intensities thus observed. An accuracy of some 5% is claimed but calibration against standard samples is required. A. H.

545.824 : 548.73 *see Abstr.* 2187

CRYSTALLOGRAPHY 548

548–15 : 535.43 = 4 *see Abstr.* 2098

548.5 : 553.621 2182

Preparation of synthetic quartz. BARRER, R. M. *Nature, Lond.*, **157**, 734 (*June* 1, 1946).—Successful crystallization of silicic acid gel is reported, and a bibliography of 17 items relating to the subject is given.

548.7 : 533.74 2183

Complete and incomplete crystals. ADDINK, N. W. H. *Nature, Lond.*, **157**, 764 (*June* 8, 1946).—The Avogadro number N can be derived from a knowledge of the dimensions of the elementary cell of a substance and its molecular weight, but this will only be accurate if the crystal has no holes in its lattice or an irregular lattice. The values of N obtained from different crystals are tabulated and discussed.

548.73 2184

Crystal structure of barium titanium oxide at different temperatures. MEGAW, H. D. *Experientia*, **2**, 183–4 (*May* 15, 1946).—Two forms (tetragonal and cubic) co-exist for an interval of several degrees around the transition temperature at 120°C. There is probably another transition near −183°C. These transitions cannot be attributed to a rotation of the molecules.

548.73 2185

An expression for following the process of refinement in X-ray structure analysis using Fourier series. BOOTH, A. D. *Phil. Mag.*, **36**, 609–15 (*Sept.*, 1945).—The expression is

$$R_2 = \frac{\sum_{hkl}\{|F_0(h,k,l)| - |F_c(h,k,l)|\}^2}{\sum_{hkl}|F_0(h,k,l)|^2}$$

where F_0 and F_c are the observed and calculated structure factors respectively. R_2 attains a minimum value when the trial structure becomes equivalent, as regards atomic co-ordinates, to the true structure; it is valuable in rejecting trial structures. Let M be the number of atoms in the unit cell and (x_r, y_r, z_r) the co-ordinates of a particular atom. If N_r is the atomic number of the rth atom and $\delta x_i = x_i - x'_i$, etc., where (x, y, z) refers to the true structure and (x', y', z') to the trial structure, it is shown that $R_2 = A + B\sum_{r=1}^{M} N_r^2(\delta x_r^2 + \delta y_r^2 + \delta z_r^2)$, where A and B are constants. This expression is used to calculate the r.m.s. error in atomic co-ordinates. L. S. G.

548.73 = 4 2186

X-ray study of mixed carbonates of calcium and barium. FAIVRE, R. *C.R. Acad. Sci., Paris*, **222**, 227–9 (*Jan.* 21, 1946) *In French.*—Barium calcium carbonate, precipitated from boiling Na_2CO_3 solution by a solution of Ba and Ca chlorides, is isomorphous with witherite for 0–35 atomic % Ca, and with calcite from 60 atomic % upwards. Between 35 and 60% both phases are present. Above 90% it is necessary to precipitate at 60°C from solutions containing 10% alcohol to avoid the appearance of aragonite. The intensity of the $\bar{1}13$ reflection from the calcite phase decreases rapidly with increasing Ba content, becoming zero at about 30 atomic %. This reflection is due entirely to the O atoms, and its disappearance is attributed to distortion of the CO_3^{--} ions by the large Ba^{++} ions. A. J. C. W.

548.73 : 535.3 : 537.531 = 3 *see Abstr.* 2123

548.73 : 545.824 2187

On new crystals to be used in chemical X-ray spectrography. AMINOFF, G. *Ark. Kemi Min. Geol.*, **16 B** (*No.* 3) *Paper* 10, 5 *pp.* (1943).—Calcite $10\bar{1}1$ (spacing 3·03 Å, mineralogical indices) and rock salt 100 (2·81 Å) are the crystal faces commonly used in X-ray spectrography. For special purposes other crystals may be used, such as gypsum 010 (7·58 Å) for obtaining a wide range of wavelengths in a single exposure, or diamond 111 (2·055 Å) or zinc blende 110 (1·92 Å) for high dispersion. The intensity of reflection and the dispersion obtainable with these and other crystals are discussed. A. J. C. W.

548.74 : 576.858.8 2188

Electron micrographs of molecules on the face of a crystal. PRICE, W. C., AND WYCKOFF, R. W. C. *Nature, Lond.*, **157**, 764 (*June* 8, 1946).—The crystals of bean mosaic virus formed by evaporation from aqueous solutions are too imperfect to investigate by the usual methods. Electron-micrographs taken with the shadow-casting technique, however, show the regular arrangement of the macromolecules on the face of the crystals, and photographs from faces of various crystal forms offer a direct means of establishing, in fact, seeing, the structure of a crystal.

GEOPHYSICS 55

550.376 : 551.465 2189

Earth currents in short submarine cables. CHERRY, D. W., AND STOVOLD, A. T. *Nature, Lond.*, **157**, 766 (*June* 8, 1946).—Measurements of the voltage appearing across the ends of co-axial submarine cables in the English Channel with short circuits somewhere along their length have revealed an alternating potential correlated to the tides. The potential is zero at slack water and is believed to be maximum at the moment of maximum flow. If the centre conductor of the cable acts as a lead between the point of short circuit and the measuring point, the voltage measured is in effect the voltage between two points on the earth. This polarity is consistent with the hypothesis that it is generated by the moving sea water cutting the earth's magnetic field.

550.835 : 537.542 *see Abstr.* 2130

550.835 : 539.164.08 *see Abstr.* 2148

550.835 : 621.318.572 2190

A portable counting rate meter for G–M tubes. MCCAHON, J. F. *N.Z. J. Sci. Tech.*, **27**, 254–8 (*Nov.*, 1945).—[Abstr. 1852 B (1946)].

551.465 : 550.376 *see Abstr.* 2189

551.495.01 2191

Theory of ground-water accumulation. LÖWY, H. *Phil. Mag.*, **36**, 651–7 (*Sept.*, 1945).—Stefan's theory of evaporation is used in a study of the infiltration of water in deserts. A vertical soil column is considered and it is supposed that the infiltration, originating from a certain shower of rain, is contained at time t in a layer between the depths h and H ($h < H$). An expression for $H - h$ is found in terms of h and the velocity with which the water infiltrates into the soil. The quantity of water which corresponds to a certain time of accumulation is also found. Some practical numerical cases are considered. L. S. G.

METEOROLOGY 551.5

551.501.7 2192

Practical methods for the determination of upper-level tendency fields. FLETCHER, R. D., AND RICE, K. A. *Bull. Amer. Met. Soc.*, **25**, 399–410 (*Dec.*, 1944).—Following Petterssen's method the geostrophic wind tendency vector is determined and the relative isallobaric field is found and from these the 6-hourly tendency vector. Charts are produced to show the winds, tendency vectors, field of pressure and pressure tendency for 10 000 ft levels. Because accurate pressure and tendency values are not often available Petterssen's kinematic rules to forecast future positions of upper level troughs and wedges are used. A method is developed and illustrated by which these movements can be determined in which pressure and pressure tendency are not used. R. S. R.

551.509.3 : 551.577 2193

An approach to quantitative forecasting of precipitation. II. Formulae for quantitative rainfall forecasting. SHOWALTER, A. K. *Bull. Amer. Met. Soc.*, **25**, 276–8 (*Sept.*, 1944).—Rainfall is computed by using moisture-flow equations where precipitation is assumed to be the residual or difference between inflow and outflow. Boundary conditions around a general rain area are obtained and the indicated excess flow of moisture converted into average depth of rainfall. In this it is essential that the outflow column or layer is saturated and that all moisture in excess of that requirement is condensed and precipitated immediately over the same general area where the moist air is liberated. Since violent convective activity gives rise to strong horizontal and vertical currents there is considerable redistribution of the condensed water before it reaches the ground. The method is of doubtful application for areas below 1 000 sq miles and best results have been obtained for areas >5 000 sq miles. R. S. R.

551.513.1 2194

The slope of axes of pressure systems. PANOFSKY, H. A. *Bull. Amer. Met. Soc.*, **26**, 101–2 (*April*, 1945).—The slope of a wedge or trough line is derived in the form $\frac{dz}{dx} = -\frac{R}{mg} \cdot \frac{T^2}{p} \cdot \frac{\partial^2 p/\partial x^2}{\partial T/\partial x}$ where p is the pressure, T the temperature, ρ density, g acceleration of gravity, R universal gas constant and m molecular weight of air. When applied to the slope of a pressure centre this shows that the displacement of a pressure centre with height occurs at right angles to the isotherms. R. S. R.

551.521.3 : 535.343.4 = 4 2195

Atmospheric ultra-violet absorption. VASSY, A. *Ann. Phys., Paris*, **16**, 145–203 (*July–Sept.*, 1941) *In French.*—Details are given of the methods of photographic spectrophotometry used, an accuracy of 1–2% being claimed. The coefficients of absorption of ozone were determined first, for bands in the regions λ4000–7500 (Chappuis), λ3000–3300 (Hug-

gins) and λ2000–2200 (Hartley). In the next section the absorption of air is dealt with and the part played by oxygen in residual absorption examined. Finally, the effect of altitude and variation of absorption with thickness of atmosphere traversed are considered.
A. H.

551.55 : 620.92 = 4 2196

Wind energy: its value and the choice of site for exploitation. AILLERET, P. *Rev. Gén. Élect.*, **55**, 103–8 (*March*, 1946) *In French.*—[Abstr. 1737 B (1946)].

551.577 : 551.509.3 *see Abstr.* 2193

551.582.2 2197

The advance and retreat of the summer monsoon in China. T'U, C.-W., AND HWANG, S.-S. *Bull. Amer. Met. Soc.*, **26**, 9–22 (*Jan.*, 1945).—Wet bulb potential temperature is used as the criterion, to identify the movement of tropical marine air masses forming the summer monsoon. Three periods of 5 days each, for each month April–September, were used over a period of 5 years or less for the stations employed. Mean values of the 5-day means were obtained and isotherms of wet bulb potential temperature were plotted to show the advance and retreat of the summer monsoon. Lack of upper air soundings and the short period decreased the accuracy of the results.
R. S. R.

551.593 : 535.37 = 4 *see Abstr.* 2091

551.594.25 : 629.135 : 621.396.821 2198

Army-Navy precipitation-static project. I. The precipitation-static interference problem and methods for its investigation. GUNN, R., HALL, W. C., AND KINZER, G. D. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 156–61P (*April*, 1946).—[Abstr. 1936 B (1946)].

551.594.25 : 629.135 : 621.317.79 : 621.396.821 2199

Army-Navy precipitation-static project. II. Aircraft instrumentation for precipitation static research. WADDEL, R. C., DRUTOWSKI, R. C., AND BLATT, W. N. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 161–6P (*April*, 1946).—[Abstr. 1937 B (1946)].

551.594.25 : 629.135 : 621.396.821 : 537.221 *see Abstr.* 2115

551.594.6 : 621.396.11.029.6 2200

Propagation of 6-millimeter waves. MUELLER, G. E. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 181–3P (*April*, 1946).—[Abstr. 1908 B (1946)].

551.594.6 : 621.396.11.029.64 2201

The effect of rain upon the propagation of waves in the 1- and 3-centimeter regions. ROBERTSON, S. D., AND KING, A. P. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 178–80P (*April*, 1946).—[Abstr. 1909 B (1946)].

553.621 : 548.5 *see Abstr.* 2182

BIOLOGY 57/59

576.342 : 615.849 *see Abstr.* 2208

576.353.088.5 2202

The effect of dose rate variations on mitosis and degeneration in tissue cultures of avian fibroblasts. LASNITZKI, I. *Brit. J. Radiol.*, **19**, 250–6 (*June*, 1946).—X-ray doses of 100 r or 2 500 r at dose-rates of 9, 29 or 100 r/min were used. Cells in mitosis, mitotic degenerations and resting cell degenerations were scored in cultures fixed at times up to 48 hr after irradiation. The percentage of degenerating cells after 100 r decreased with increase of dose-rate; after 2 500 r it increased with increase of dose-rate. A split dose (2 fractions of 1 250 r at 100 r/min separated by 5 hr) was more effective than a single dose (2 500 r at 100 r/min), owing to the greater number of mitotic degenerations produced. D. E. L.

576.858.8 : 548.74 *see Abstr.* 2188

577.15.037 2203

Biological effects of high-frequency currents. JACKSON, W. *Lancet*, **250**, 519 (*April* 6, 1946).—Nyrop's inference [Abstr. 923 (1946)] that the specific effects are not of thermal origin is questioned. The possibility of frequency selective action on particular bacteria, etc., seems to justify investigation; and the use of his technique and of frequencies much higher than 20 000 kc/s merits serious consideration. C. J. G.

591.181 : 616–073.788 *see Abstr.* 2210

MEDICAL SCIENCE 61

614.485 : 535.39 : 535.345.1 *see Abstr.* 2086

614.71–078 : 621.359.4 2204

Sampling air for bacterial content. LUCKIESH, M., HOLLADAY, L. L., AND TAYLOR, A. H. *Gen. Elect. Rev.*, **49**, 8–17 (*March*, 1946).—A portable apparatus is described for determining rapidly the number of bacteria per unit volume of air in any space. The air is made to flow through an inverted funnel on to a nutrient spread in a glass dish, and the number of colonies produced by subsequent incubation is counted. High efficiency of capture is achieved by applying an electric field of the order of 7 000 V per cm to the collecting space, and in the Duplex Sampler two collectors in series in the air flow are used with fields of opposite polarity. Photographs of the collecting dishes after various exposures illustrate the quantitative performance of the apparatus. F. T. F.

615.831.7.08 : 536.33.08 2205

The measurement of infra-red radiation for medical purposes. EVANS, D. S., AND MENDELSSOHN, K. *J. Sci. Instrum.*, **23**, 94–8 (*May*, 1946).—Simple computation of dosage in terms of the characteristics of the primary radiation source is of little value. In any particular arrangement of apparatus radiation reaches the patient from the heating elements, the glass envelopes of the lamps, and the metallic reflectors forming the treatment cradle. The calculation of energy distribution from these complex sources is far too elaborate for routine practice. Furthermore, direct measurement of the radiation at any point by the usual vacuum radiation meters is ruled out because of the long wavelength radiation emitted by the reflecting parts of the apparatus. An instrument is described for the direct measurement of the total flux received on the skin of a patient at any point. A copper disc receives the radiation, and its temperature rise is indicated by means of a thermo-

couple. To take account of variations in ambient temperature a second disc and thermocouple, screened from radiation, is attached, and the two couples used differentially. The response is linear up to 6 cal/cm²/min, with a reproducibility of results better than 5%. For the calibration of the clinical instrument, a differential radiation calorimeter is described. A physical theory of the action of the instrument is developed. J. E. R.

615.849 2206

Some observations on X-ray treatment cones. EDDY, C. E., AND STEVENS, D. J. *Radiology*, **46**, 176–83 (*Feb.*, 1946).—Whilst accurate measurements can now be made of the output of X-ray apparatus in terms of skin and depth dosage, in actual application of the radiation this accuracy may be offset by the bad design of an application cone. Such cones are of two types, one in which the upper aperture is large and the beam is limited by X-ray-opaque walls and the other where the beam is only limited by the upper aperture. The authors are of opinion the latter is preferable. The radiation fields of such cones can be checked by photographic examination, examples being given of faulty cones so detected. Pin-hole camera photographs permit control of their correct orientation in relation to the focal spot of the X-ray tube. Particularly in the case of small cones, intended for insertion into the body cavities, incorrect orientation of the X-ray tube may result in the radiation being uselessly absorbed by the protective material of the cone, instead of by the body tissues as intended. B. J. L.

615.849 2207

The mechanism of the action of radiation on tissues and its application to the treatment of malignant disease. ELLIS, F. *Brit. J. Radiol.*, **19**, 153–4 (*April*, 1946).—The mitosis of cells is inhibited by radiation and irradiated cells degenerate during or after mitosis. A possible explanation is given on the basis of experimental evidence that there is an accumulation of ribose nucleotide in the cytoplasm of irradiated cells, and that chromosome breaks are produced by radiation. Observations of the effect of the fractionation of dose on the production of a skin erythema have been analysed on the chromosome break hypothesis and it is shown that results of some clinical interest are obtained. H. M.

615.849 : 576.342 2208

Newer investigations of radiation effects and their clinical applications. REYNOLDS, L. *Amer. J. Roentgenol. and Radium Ther.*, **55**, 135–52 (*Feb.*, 1946). —Theories of the action of radiation on cells are first reviewed. The author then describes experiments on the osmotic pressure of proteid cells, using an osmometer which is described and illustrated in detail. The chemical constitution of proteids is then discussed in relation to chemical chain formation and the spatial arrangement of the atoms in polypeptide chains, generally and in groups, based on the work of Sponsler and of Wrinch. These complicated atomic structures are not inert but change under physical and chemical action and can be disrupted by secondary electrons. Lecithin, the structure of which is illustrated as a typical example, is one of the most important constituents of brain tissue, with strong polarizing powers. Experiments with X-rays have been carried out in the past few years by irradiation of the brains of dogs and, in the case of human subjects, by post-mortem preparation of specimens taken from subjects clinically irradiated before death. The paper is illustrated with reproductions in colours of histological preparations. B. J. L.

615.849.5 : 621.386.82 : 537.531 2209

The history of dosimetry in Roentgen therapy. QUIMBY, E. H. *Amer. J. Roentgenol. and Radium Ther.*, **54**, 688–703 (*Dec.*, 1945).—Reviews the development of methods to measure X-ray dosage and quality of radiation. An extensive bibliography is given. B. J. L.

616–073.788 : 591.181 2210

Delimitation of subcortical tumours by direct electrography. WALTER, W. G., AND DOVEY, V. J. *Lancet*, **250**, 5–9 (*Jan.* 5, 1946).—A description is given of a method for obtaining records of the electrical activity of the deeper tissues in the brain which can be used to supplement conventional methods of identifying and locating subcortical tumours at operation. The physiological interpretation of the records, improvements in the technique and subjects for further study are discussed. The electrical silence of new growth is not surprising as only mitosis could produce electrical changes in such tissue; the chance of a cell division taking place in the tissue close to the electrode during the recording is vanishingly small. C. J. G.

666.1.037.5 : 533.5 : 669.278 *see Abstr.* 2211

669.278 : 533.5 : 666.1.037.5 2211

Coppered-tungsten seals through hard glass. REIMANN, A. L. *J. Sci. Instrum.*, **23**, 121–4 (*June*, 1946).—A process is described for providing W with an adherent and structurally sound sheath of Cu, which flows into and fills up any cracks. This process can be used for making vacuum-tight seals through glass with split W wires.

771.35 : 535.87 : 535.313 = 4 *see Abstr.* 2071